(*From the Author.*)

THE

Geological Survey

OF OHIO.

Reports on the Counties of

Sandusky, Seneca, Wyandot and Marion.

BY

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Geological Survey of Ohio.

GEOLOGICAL MAP OF SANDUSKY COUNTY.

BY

N.H. WINCHELL,

Explanation of Colors.

7	Corniferous Limestone
6	Oriskany Sandstone
5	Water Lime
4	Salina
3	Niagara Group

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Charles S. Prosser 2259

CHAPTER XXVI.

GEOLOGY OF SANDUSKY COUNTY.

SITUATION AND AREA.

Sandusky county has Ottawa on the north and Seneca on the south. It is bounded west by Wood and east by Erie. It contains twelve towns, or four hundred and thirty-two square miles. In its north-eastern corner it touches Sandusky Bay. Its greatest dimension is east and west thirty miles. Its form is that of a rectangular parallelogram.

NATURAL DRAINAGE.

The Sandusky river, which intersects it about midway in a direction a little east of north, and enters Sandusky Bay in Riley township, is the chief river of the county, and is navigable to Fremont by reason of slack water from the bay. Below Fremont the immediate river channel is crooked, and the stream widens out into bayous, covering considerable low land. Above Fremont its course is more direct, and it lies almost constantly on the rock, which offers abundant exposure, to the south line of the county. The Portage river also crosses the north-west corner of the county, passing through Woodville township and village. Besides these, which may be relied on for a constant flow of water, even in the driest seasons, there are numerous creeks, whose direction is also north-easterly. Some of these are also constant-flowing streams, but the most of them cannot be depended on for water-power purposes. Such are Sugar creek, Big Mudd creek, Muskalunge creek, Green creek, and Raccoon creek. Wolf creek, also, which enters the Sandusky from the south-west in Ballville township, drains a considerable tract of country, and has a constant current. Of these, the Green creek, whose chief supply is the sulphureted water from the mineral springs in Green-creek township, is a constant stream, and at the present time affords power for several mills.

SURFACE FEATURES.

With the exception of the township of York, and small parts of Townsend and Greencreek, in the eastern portion of the county, the surface is generally a monotonous plain. Being included in that tract long and well known as the Black Swamp, its features to many persons are best expressed by giving it that title. As in Ottawa county, the limestone ridges, sometimes capped with lacustrine sand, are the only observable changes of level. They are more frequent, especially in the western part, than in that county, and sometimes a number of fields are so stony, or the rock is so near the surface, that the land is used only for pasturage. Their height, with the addition of the sand deposit, sometimes amounts to twenty-five or thirty feet; but the ascent is very gradual, and distributed often over half a mile. In Scott township, in the south-western part of the county, there are patches of natural prairie. These are due to imperfect natural drainage. The undulations in the surface of the Niagara limestone, over which they occur, operated, by the aid of the drift, to confine shallow pools of water upon the retirement of the lake. Usually the low, continuous, rocky rim can be detected jutting a few inches or feet above the surface, or sometimes rising in the form of conspicuous ridges. Such shallow pools would eventually become marshes, where vegetable deposits would accumulate, and at last, when the surrounding country had become forest-covered, they would appear as prairies. It is a common coincidence in the Black Swamp that the most stony tracts are also the wettest. Had the original drift been undisturbed by the waves of the lake, such confined pools would have been likely to work out for themselves some escape through the more erosible materials, and to have become clothed sooner with the indigenous forest.

The valleys of the streams are worn in the drift. That of the Sandusky is fifty-three feet, to the water level, at Fremont—sixty-five to the bed of the river. At Ballville the river is running on the rock, and its surface is forty-seven feet five inches below the general level. Its banks, consisting of the stiff hardpan, or sometimes superficially laminated, are abrupt, and very often steep, although one or the other is frequently from fifty to one hundred rods from the channel of the river. The height of the flood-plain varies in accordance with the obstructions to the current, but at Fremont it is but four and a half feet above the level of slack-water. This, however, cannot express the average height of the flood-plain, but rather shows the rise of Lake Erie under the influence of spring freshets. Below Fremont, the valley of the river is broader, and the accumulated waters have freer escape. Above that point the flood-plain

sometimes rises ten and twelve feet above summer stage of the river. Bordering and enclosing the flood-plain, the drift banks rise from thirty to forty feet, and constitute by far the most noticeable changes of level to be seen in the county. These banks are not confined to the larger streams, but seem to be as deeply cut along some of the creeks as along the Sandusky river. In traveling the "river road," one cannot but be struck with the frequency and depth of the tributary valleys. These little valleys are often occupied by streams only in the spring and fall of the year, but the moist and loose state of the drift at those seasons combines with the activity of the current to wash out their valleys as deep as that of the main stream.

In the south-eastern portion of the county the surface contour is quite rolling, and in the monotony of the general aspect elsewhere, might be styled picturesque. For a full discussion of the causes and changes that introduced this rolling, sandy tract, in Sandusky county, the reader may consult a preceding chapter on the drift in north-western Ohio.

SOIL AND TIMBER.

The soil is clay, with a little gravel, being the old drift surface, and has a depth corresponding to the thickness of that deposit. Local circumstances have added accidental qualities in various parts of the county. In localities, poorly drained by the natural conformation of the surface, considerable addition of partially decayed vegetable remains has given it a peaty composition, and a black color. Places subject to erosion have become gravelly or even stony, the fine constituents of the drift having been washed out, while the action of the waves of Lake Erie, over much of the county, has served to heap up isolated sandy knolls and to deposit a heavy accumulation of sand in the south-eastern part of the county. While the soil of the whole county is fertile and adapted to all farm products, the warmth and quickness of the sandy soils, in the townships of Townsend, York and Greencreek, united with a pleasant, undulating surface, and the ease of drainage, have given the lands of these townships for the time being an enhanced market valuation. When, however, the county becomes more perfectly subjected to artificial drainage, the clay soils will remain the chief source of agricultural wealth, when perhaps the lighter soils have become exhausted. The most of the county was originally covered with low-land varieties of timber. Elm, hickory, cottonwood, beech, ash, the various species of oak, maple, with some black walnut and honey locust, may be seen in traveling over the county. In a few places trees of pepperidge and of chestnut were also seen. Much of the sandy tract in the south-eastern part of the county was known among the early settlers as "oak openings."

GEOLOGICAL STRUCTURE.

The rocks underlying the county belong to the Upper Silurian and Devonian ages, the highest being the Corniferous. They embrace—

Upper Corniferous limestone	Devonian.
Lower Corniferous limestone	
Oriskany sandstone	
Water limestone	Upper Silurian.
Salina shale	
Niagara limestone	

The *Niagara* occupies two belts of anticlinal outcrop across the county north and south. The boundaries of the eastern belt are not certainly known, and the map of the county is to be regarded as conjectural throughout the most of that area. The outcropping edges of the western belt have, however, been carefully traced across the county, owing to the frequent exposures of water-worn surfaces which there occur. The western boundary of the western belt enters the county from the north in Sec. 8, Woodville, and runs nearly south, gradually approaching the county line, which it crosses in Sec. 6 in the same township. The eastern boundary of this belt enters the county, N.E. ¼ Sec. 27, Washington township, in a south-easterly direction, which it keeps for about four miles, when it turns to the south and south-west, again south, leaving Washington township, S.E. ¼ section 34. It keeps a southerly course, crossing the Lake Erie and Louisville railroad a mile north of Winter Station, nearly to the ocunty line, when it is suddenly diverted eastward, and leaves the county, S.E. ¼ Sec. 31, Ballville township. The only exposures of the east belt of outcrop are at Fremont, where it can be seen below the dam near the railroad bridge, and at Moore's mill dam, near Ballville. These are on the western border of the belt, which has a width of about six miles. The western portions of the townships of Riley and Greencreek, and the eastern portions of Rice, Sandusky and Ballville, are probably underlain by the Niagara.

In the western part of the county, where the drift has been considera bly eroded by the action of the waves of Lake Erie, the rock is very often laid bare. The following list of outcrops, which is probably far from complete, will give some idea of the denudation that has taken place. There is, however, no evidence of a beach line where the shore of the lake stood stationary. The shore line seems rather to have begun at once a

slow recession. In the township of Woodville the following were noted, not including those in the bed of the Portage:

N.W. ¼ Sec. 22. This ridge runs several miles easterly, rising also on the south side of the Portage. At Woodville it is capped with sand.

N.W. ¼ Sec. 9. This ridge runs to Genoa, in Ottawa county, and is known as *Trimmer's Ridge.*

S.W. ¼ Sec. 35. Considerable surface exposure of gray and crystalline Niagara.

S.W. ¼ Sec. 36. Thick-bedded, crystalline Niagara, affording a fine building stone.

S.W. ¼ Sec. 5. Ridge of Niagara, running north and south, showing characteristic Niagara fossils, on the land of Jacob Sanders, and others.

S.W. ¼ Sec. 6. Land of John Caler. This ridge has been excavated for a cellar, and the stone is a very light drab, weathering buff. It is porous, and often carious, in rough and irregular, also in even, beds; the even beds are sometimes a foot thick. Under the weather it often crumbles much like chalk. The ridge holds a deposit of sand.

IN MADISON TOWNSHIP.

S.E. ¼ Sec. 27. Niagara ridge crosses the road.

S.W. ¼ Sec. 34. Niagara ridge.

S.E. ¼ Sec. 34. Niagara ridge.

Sec. 35. On the town line.

S.W. ¼ Sec. 10. At the crossing of the creek.

S.W. ¼ Sec. 7. Land of A. J. Nolan. Rock similar to that in Caler's ridge, S.W. ¼ Sec. 6, in Woodville township.

IN WASHINGTON TOWNSHIP.

N.W. ¼ Sec. 32. A low ridge of Niagara; is worked a little near Lindsay for foundations to farmers' houses, on land of Mr. Behring, and of Mr. Hagerman.

S.W. ¼ Sec. 3.

N.E. ¼ Sec. 10. In the bed of Big Mudd creek; dip E. about 4°.

S.E. ¼ Sec. 11. Near the railroad crossing of the highway; dip apparently east.

N.W. ¼ Sec. 11. Under the railroad bridge.

N.E. ¼ Sec. 8. Crossing of Nine-mile creek.

S.E. ¼ Sec. 20.

S.W. ¼ Sec. 17.

S.W. ¼ Sec. 14. A ridge running east and west, rising about fifteen feet.

S.E. ¼ Sec. 29. Niagara ridge.

Sec. 32. At two points half a mile separate, in ditches by the roadside.

IN BALLVILLE TOWNSHIP.

S.E. ¼ Sec. 31. J. Bruner quarries the Niagara; dip east.

S.W. ¼ Sec. 31. Land of Amos Mull. In the bed of the creek.

IN SCOTT TOWNSHIP.

S.W. ¼ Sec. 4. Land of William Boor. Ridge runs nearly north and south.

S.E. ¼ Sec. 4. Ridge of Niagara on John Houtz's land; Peter Rust also has land on this ridge.

N.W. ¼ Sec. 9. Land of Daniel Shively.

N.E. ¼ Sec. 9. Much stony land.

Secs. 31 and 30. "Stony Barter."
Sec. 3.
Secs. 17 and 16.
Sec. 28.
} In the midst of prairie.

IN JACKSON TOWNSHIP.

N.E. ¼ Sec. 4. Ridge of Niagara, half a mile east and west.

S.W. ¼ Sec. 3. Niagara in a field; dip E.

S.W. ¼ Sec. 4. In a ditch by the roadside.

S.E. ¼ Sec. 3. On the farm of Mr. Burkett.

S.E. ¼ Sec. 15. Prominent ridge.

S.E. ¼ Sec. 27. Ridge crosses the road.

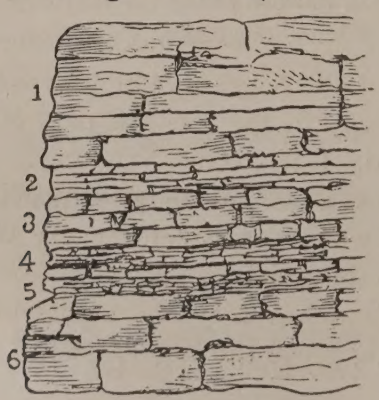
N.E. ¼ Sec. 34. As a ridge.

S.E. ¼ Sec. 35. In the creek, land of Riley Betts.

S.W. ¼ Sec. 35. In the west branch of Wolf creek, within thirty rods of the county line road, the Niagara is seen dipping west at an angle of eight degrees, exposed about two feet. It is overlain by Waterlime containing *Leperditia alta*, in thick, rough beds, showing two feet and three inches, followed by about a foot of shattered, thin beds. The Waterlime seems here to lie conformably over the Niagara, and dips with it toward the west.

The section at Moore's mill, near Ballville, exposes the superposition of the Waterlime and Salina over the Niagara.

Section including the Salina, at Moore's Mill.



EXPLANATION OF FIGURE.

No. 1.	Thick-bedded, drab, used for building	6 ft. 6 in.	Waterlime, 15 feet.
No. 2.	Thinner-bedded, drab, more sectile, weathers lighter	1 ft.	
No. 3.	Beds about six inches, drab, used for building	3 ft.	
No. 4.	Beds three to six inches, drab	4 ft. 6 in.	
No. 5.	Green shale, passing horizontally into an impure, bluish-drab stone	1 ft.	
No. 6.	Bluish-gray Niagara; beds thick, hard and crystalline, exposed	3 ft.	

The Waterlime immediately overlying the shale, contains the characteristic fossil *Leperditia alta*. The Salina shale (No. 5) appears in patches, gradually becoming a rather firm and blue stone. Sometimes irregular beds of fragile, earthy limestone appear within the shale, projecting conspicuously after the shale has crumbled out. On exposure to the air, the shale turns blue and crumbles. Its deposition seems sometimes to have been distributed through the first few feet of the Waterlime above, instead of being concentrated in a single bed. In such cases the Waterlime is blue-drab near the base, and if porous and crystalline, it is with difficulty distinguished from the Niagara. No. 6 is in the bed of the river, and crosses it just below the dam, the water falling upon it. It lies as an anticlinal with axis N. W. and S. E., rising toward the N. W. and producing an upward swell in the overlying drab beds. The section below the railroad bridge, at Fremont, cannot be made out with certainty, owing to the prevalence of the water. Five feet and five inches can be seen of gray, crystalline Niagara, in beds of eighteen to twenty-eight inches. Overlying this, but below the water of the river, are about two feet of earthy, drab Waterlime in beds from two to six inches. The Salina, if it exists here, cannot be seen. The whole dips six to eight degrees south, ten degrees east. It formerly rose considerably above the bank, along the road near the railroad bridge over the highway, and was quarried there for walls and abutments, the stone for the railroad bridges having been obtained there.

The Guelph phase of the Niagara, which appears at Genoa, in Ottawa county, is met with only in the western part of Sandusky county, and near the Wood county line. The Niagara is usually a hard, thick-bedded, crystalline rock, which, although requiring considerable labor in quarrying, furnishes, whenever systematically and persistently worked, an excellent and valuable stone for building. It must be admitted, however, that the formation has not been sufficiently opened, within the limits of the county, to prove the non-existence of the Guelph in other portions.

The *Salina Shale*, which immediately overlies the Niagara, has been

seen at but one point in the county. As already mentioned, it has a thickness of one foot at Moore's mill, but further north it was penetrated by drilling, according to Mr. G. G. Tindall, of Fremont, a thickness of eleven feet before the drill struck the Niagara. It perhaps underlies the eastern part of Riley and the northern portion of Townsend townships, for it certainly has a greater thickness toward the north. Sandusky bay is doubtless an excavation, to a large extent, in the Salina shale.

The Water Limestone occupies that portion of the county west of the western belt of Niagara, the strip included between the two Niagara areas, which lies west of Fremont, and includes the most of the townships of Ballville, Sandusky and Rice, and portions of Jackson and Washington, together with an area not distinctly defined, crossing the eastern part of the county through Greencreek and Townsend townships. This formation appears very much as it does in Ottawa county, and presents the three different lithological phases. The frequency of its exposures in the western portion of the county is equal to that of the Niagara. The "limestone ridges" which it causes are very often covered with sand which lies in hummocky contour. Its most important exposures are at Fremont, where the ridge it there produces has been extensively wrought for lime, and for general use in walls and rough paving; and at Ballville, where the river has excavated a channel through it, so as to expose upward of thirty feet of bedding. Aside from these, which will be separately described, the Waterlime was seen in outcrop in the following places:

IN WOODVILLE TOWNSHIP.

N.W. ¼ Sec. 31. Land of D. H. Rex; thick-bedded soft Waterlime, furnishing a good building stone; dip S. W. 4 degrees. This ridge runs north, ten degrees east, and is about two miles long.

Sec. 6. Near the county line, in the Portage; also half a mile east.

N.W. ¼ Sec. 32. Thick-bedded, drab; in the bank of the Portage, ten feet above the water.

IN WASHINGTON TOWNSHIP.

N.E. ¼ Sec. 25. Near the Ottawa county line, the *Ruhl ridge*, consisting of brecciated Waterlime, rises about six feet.

N.W. ¼ Sec. 23. Waterlime which contains the fossil *Leperditia alta.*

S.W. ¼ Sec. 14. Even-bedded Waterlime dipping N. E. within fifty rods of gray Niagara limestone, which forms a ridge running E. and W., and rising about fifteen feet. The Niagara lies west of the Waterlime, and between them are several clumps of brecciated Waterlime showing *Leperditia alta.*

N.E. ¼ Sec. 27. Waterlime ridge east and west, with a deposit of sand.

S.W. ¼ Sec. 36. In a ditch by the roadside; also in a field adjoining.

N.E. ¼ Sec. 13.

IN JACKSON TOWNSHIP.

N.E. ¼ Sec. 10. Fragile beds of soft Waterlime have been used for the "Greensburg pike." Beds horizontal so far as discernible, the quarry being in low ground and filled with water.

N.E. ¼ Sec. 11. Sandy knolls, which probably lie on Waterlime.

S.W. ¼ Sec. 2. Intersection of the "Greensburg pike" and Muskalunge creek.

S.W. ¼ Sec. 35. In thick, rough beds, overlying the Niagara, and followed by a foot of thin beds.

N.E. ¼ Sec. 35. In the N. Branch of Wolf creek.

IN BALLVILLE TOWNSHIP.

S.E. ¼ Sec. 6. This ridge is remarkably overstrewn with northern bowlders.

S.E. ¼ Sec. 19. In the road, joining James Wickard's land; also on John Halter's land in the bed of the creek.

S.W. ¼ Sec. 30. Near a steam sawmill, in the W. Branch of Wolf creek.

N.W. corner Sec. 31. Land of D. Mull, in the bed of the creek.

N.W. ¼ Sec. 29. From this place to Ballville the Sandusky river lies immediately on the Waterlime.

IN SANDUSKY TOWNSHIP.

S.E. ¼ Sec. 32. Burned for lime.

N.E. ¼ Sec. 32. Burned for lime.

S.E. ¼ Sec. 19. At the Four-mile house; furnishes some large, rough blocks for walls and abutments.

About half a mile west of the depot, at Fremont, the Waterlime is extensively burned into lime. Quarries have been opened by D. L. June, Daniel Quilter, Philip Gottern, and by others. The stone disclosed in these quarries is a light drab, usually thin-bedded stone, close textured and even flinty in some parts. Mr. June has penetrated, in his quarry, through the Salina, and entered the Niagara. The openings were at first made in the summits of gentle anticlinals, the rock dipping, as it is exposed on working deeper, in opposite directions. This is the case with the three principal openings, viz.: those of June, Quilter and Gottern. The following section, from Mr. June's quarry, may be taken as a fair illustration of all of them:

Downward Section of the Waterlime at Fremont, including the Salina, and the upper part of the Niagara.

No. 1. Beds two to four inches, separated by bituminous films, generally close-grained, but sometimes vesicular and crystalline; disturbed with nodules and thin beds of chert..... 10 ft. 6 in.

No. 2. Beds two to six inches, more even and with less chert, the mammilated surfaces separated by bituminous films; used for flagging... 9 ft.

No. 3. The same as the last, or changing horizontally to a thick-bedded or massive, softer stone, exhibiting the lithological characters of phase No. 2. The bedding here is sometimes disturbed by dome-shaped or concretionary masses; useful for paving and general building, and as a cut stone..... 2 ft. 6 in.

No. 4. Salina shale; in some places wanting; or replaced by a thin film of bituminous matter, with some harder and more rock-like beds..... 6 to 12 in.

No. 5. Gray, thick-bedded, non-fossiliferous, vesicular Niagara, with some galena exposed ..... 3 ft.

The dip in Mr. June's quarry is S. W. and N. E., at angles of fifteen to twenty degrees, in opposite directions. Mr. Quilter's quarry is about 180 rods south-west from Mr. June's, and the rock, which is apparently on the same horizon, also dips S. W. and N. E. with about the same angles. Mr. Gottern's quarry, about sixty rods south of Mr. Quilter's, has an east and west anticlinal axis, the dip being about ten degrees in either direction. A little to the south-west of Mr. June's quarry, and between it and Mr. Quilter's, may be seen a number of clumps of rough, cavernous, brecciated Waterlime, which must overlie all the rock of the quarry, and doubtless corresponds to the upper part of the exposure in the Sandusky river, at Ballville, which is as follows:

Downward Section of the Waterlime at Ballville, below the bridge.

No. 1. Thick-bedded (2 to 3 feet), porous, rough and crystalline, or massive and brecciated, of a drab color..... 8 to 10 ft.

No. 2. Thin-bedded, drab, with streaks of darker color and more compact texture, occupying the bed of the river, and rising a few feet above the water along the south bank. This member is filled with curious concentric, ellipsoidal laminations; exposed..... 6 ft.

Between Ballville and Moore's Mill, half a mile up the river, the formation is nearly horizontal, or has a slight dip to the east, but shows such local flexures, whenever visible, that no reliance can be placed on the dip in correlating the outcrops. Judging, however, by the lithological characters, the outcrop at Fremont may be united with those in the Sandusky river, so as to produce the following general section of the lower part of the Waterlime:

General Section of the lower part of the Waterlime in Sandusky County, in descending order.

No. 1. Massive, or thick-bedded, often brecciated, exposed between June's and Quilter's quarries at Fremont, and in the left bank of the Sandusky river just below Moore's mill. (No. 1 of the section at Ballville). Phase No. 1..... 10 to 15 ft.

No. 2. Thin-bedded, drab, cherty, with bituminous films, (Nos. 1 and 2, at June's quarry). Phase No. 3. Generally close grained. The lower portion of this sometimes, as at June's, passes into thick beds of a softer and coarser texture, when it has the features of phase No. 2 ..... 25 feet.

THE ORISKANY SANDSTONE.

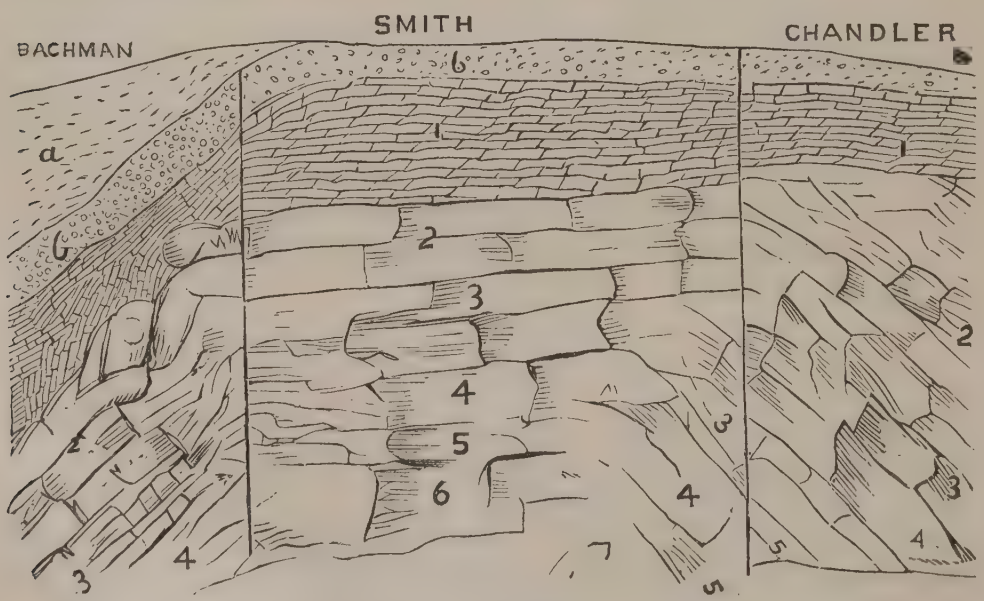
This is represented in Sandusky county by thin arenaceous layers at the base of the quarries of Messrs. Smith, Bachman and Chandler at Bellevue, (see sections of these quarries, p. 604). On fresh fracture it is a handsome blue, or mottled with drab and blue. In other counties this sandstone is ten or fifteen feet thick, but here it is not over two. Its only use heretofore has been for macadamizing roads, for which it is admirably adapted. Yet recently Mr. Smith has succeeded in making a water-lime cement from this stone, the sand contained within the mass answering for that usually mixed with the cement by the masons. The individual grains of sand are quite distinct, and often large enough to be called gravel. The larger are from a half to three-fourths of an inch across, and have much the aspect of fragments of earthy, close-grained, drab limestone, others are cherty or silicious, and pass into quartzite. These larger pieces are, however, very rare, the mass being a homogeneous sand in rounded grains.

This sandstone is overlain by six feet of the Waterlime formation, or at least by that amount of thick-bedded, drab limestone, with wavy bituminous films, and all the lithological characters of the Waterlime. Hence it seems that the Oriskany, or at least the sandy phase which is here supposed to represent the Oriskany, is not always in the same stratigraphical horizon. This fact is more fully confirmed by observations made in Wood and Paulding counties.

CORNIFEROUS LIMESTONE.

The Corniferous limestone is next higher in the geological series. It is separated into two parts, the *Upper* and the *Lower*, which are not only stratigraphically, but also lithologically distinct. The Lower Corniferous comprises the greater part of the rock exposed in the quarries of Messrs. Bachman and Chandler, at Bellevue, and the upper portion of Mr. Smith's at the same place. Mr. Emery Farnsworth also has opened a quarry in the same, near that of Mr. Chandler. The Upper Corniferous is seen in the quarry, now abandoned, within the corporate limits of Bellevue, as well as in Mr. Samuel Huffman's, N.E ¼ Sec. 25, York township, and in Mr. John Stetler's N.E. ¼ Sec. 34. The former is a buff-

colored, rather coarse-grained, magnesian limestone, rough to the feel, and often disturbed by irregular nodules or almost continuous beds of chert. The latter is a bluish gray, crystalline, hard stone, in even beds, which are usually conspicuously fossiliferous. This formation underlies the most of York township, and the south-eastern part of Townsend. It produces a more elevated tract of country wherever it occurs in north-western Ohio; and in Sandusky county, in connection with the St. Lawrence glacier, and the subsequent action of the shore line of Lake Erie, has given to the townships of York and Townsend the topographical and agricultural features which are in so marked a contrast with the rest of the county. Approaching from the south-west across the State, several of the ridges converge toward Bellevue. West from Bellevue the surface descends, and it is only at points considerably further south that the same altitude is reached. Hence the "lacustrine region" rapidly widens toward the west, just as the glacier was also more easily prolonged in that direction than in any other. The shattered condition of the rock in the quarries at Bellevue, and in Thompson township, Seneca county, attests the violence of that force which last acted on them, and indicates that the Corniferous limestone was the pivot on which the glacier swung in emerging from the rocky barriers that confined it further east along the Lake Erie shore.



Corniferous, Oriskany, and Water Lime, Bellevue.

The above section, which includes the adjoining quarries of Lyman Chandler, James F. Smith and Jacob Bachman, at Bellevue, while it

shows the disturbed condition of the formation at that point, also is interesting because it is the only place in the county where the relations of the Waterlime, Oriskany and Corniferous can be seen. This whole section is remarkably shattered, and the layers to the depth of thirty feet are thrown down from their natural position eight or ten feet, sometimes lying nearly on their edges.

EXPLANATION OF FIGURE.

Drift.	*a.* Fine sand in a massive bank; without stratification, containing the sticks and bark of White Birch	12 ft.
	b. Unassorted, gravelly drift	4 ft.
No. 1.	Beds two to four inches; buff; rough; magnesian; unfossiliferous: with continuous beds of chert	8 ft.
No. 2.	Magnesian and rough, with some sand, especially in the lower part; buff; beds 24 to 40 inches	10 ft.
No. 3.	Dark drab; striped with wavy and bituminous films; soft when weathered; harder and somewhat blue below; mainly in two beds	3 ft.
No. 4.	Dark drab; dense so as not to weather or bleach white; its upper six inches are much lighter, and earthy-magnesian; separated from No. 3 by a thick, constant, bituminous film. Below it becomes arenaceous, and is of a light blue on deep fracture, which, however, soon fades, turning a grayish buff with rusty films and streaks; in one bed	3 ft.
No. 5.	Sandstone, of a handsome blue color, like the lower part of No. 4. Beds of about two inches, separated by thick bituminous films; rather fragile	1 ft.
No. 6.	In thick beds, or massive; often rough, porous and crystalline. On fracture of a massive bed, the section shows a wavy and curly, internal stratification, with alternating strips of lighter and darker drab; contains large masses of coarse crystals of calcite, and indistinct impressions of *Leperditia alta.* Exposed	4 ft.

It will be noticed that besides the arenaceous layer No. 5, there is also considerable sand in No. 2. Although this holds the place the Oriskany ought to have, viz: the base of the Corniferous, it is more likely to be represented, as already stated, by No. 5.

In Mr. Smith's quarry, No. 3 is more bleached, appearing in that condition more brittle, and fracturing somewhat like chalk, although much harder. When thus broken the bituminous films appear as rusty, wavy marks across the section. It is one of the most prized portions of the quarry, both for the whiteness of the lime it makes, (hence is distinguished by the workmen as "The White Stone,") and for the thick, even blocks it affords for walls and general building.

The *Upper Corniferous* is a hard, gray, crystalline stone, which has a thickness of something over forty feet, and contains interesting fossil

remains. Its regular bedding easily separates into flagging, or is broken into stone useful for all building. It is used for both purposes, and from Sandusky, in Erie county, it is extensively exported to distant points.

THE DRIFT.

This deposit covers the whole county with a nearly uniform spreading. No reliable actual measurements of its thickness have been made in the county, but its average thickness would probably not exceed one hundred feet. It seems to be somewhat thicker in the eastern half of the county than the western, owing to denudation by the old lake shore over the area of the Niagara limestone. It is usually a typical, unassorted and unstratified glacial deposit or hard-pan. Occasional places of oblique stratification may be referred to the action of water issuing from the glacier, and do not affect the general glacial origin and non-stratified condition of the great mass. The stratification of the drift exhibited in the banks of the Sandusky river, at Fremont, is confined to the upper twenty or thirty feet. The character of its junction with the unstratified hard-pan below, seems to indicate the presence of the glacier at the time the stratification was forming, or at least at the time of its commencement. It is probably due to running water, and may be assigned to the action of the Sandusky river, which, being set back by the retreating foot of the glacier, would spread over a considerable lateral surface. This would necessitate the flow of the Sandusky considerably above its present level. It may be referred, perhaps, with more reason, to the effect of water issuing from the glacier, and spreading uniformly over the surface along its retreating foot, depositing a stratified material free from gravel and stones, owing to the distribution of its current over a wide, shallow valley. This would also account for the occurrence of similar laminations at points, removed from the Sandusky river, and where they cannot be ascribed to the effect of any stream at present existing.

MATERIAL RESOURCES.

Being mostly included in that area known as the Black Swamp, Sandusky county has an inexhaustible store of wealth in the strong and deep soil so characteristic of that tract. The industries of the people are mainly agricultural. Nevertheless the development of the resources embraced in the underlying formations has not been neglected. The Niagara limestone has been opened in a number of places in the western part of the county, and has been found to supply a stone equal, in every respect, for purposes of building, to the famous Dayton stone, of southern

Ohio. If an effort were made to introduce this stone into the markets of Toledo and Detroit, owing to cheaper transportation, it would probably exclude those distant quarries from the northern trade. At the present time but little more is done than to meet the local demand.

The quicklime made from the quarries of Messrs. June, Quilter and Gottern, in the Waterlime formation at Fremont, has a wide reputation and sale, particularly in eastern cities. It is extensively shipped to Pittsburg, Pa., for use in the manufacture of glass. It also goes as far as Philadelphia and Boston. This lime furnishes more nearly the qualities of the Waterlime, when used for this purpose, than the quarries in the same stone at Genoa, in Ottawa county, and it will probably better answer the description there given, and more exactly bear out the comparison to the Niagara, than that burned at Genoa. It is not a pure white, but has a faint tint of yellow. It requires, however, to be seen in bulk to render the yellow tint discernible.

The following list of lime-burners, with the annexed columns, will show the comparative qualities of the Niagara, Waterlime and Corniferous, in their adaptation to the manufacture of quicklime. This list is made out from the statements of the proprietors themselves, or their foremen, and is as nearly correct as can be made without extensive trials and comparisons:

Name of Firm.	Location.	Formation.	Cords of wood per 100 bushels.	Weight per bushel of bulk.
				lbs.
D. L. June and Son ..	Fremont, Sandusky Co.	Waterlime	1	75
Daniel Quilter	Fremont, Sandusky Co.	Waterlime	2½	75
Phillip Gottern	Fremont, Sandusky Co.	Waterlime	2½	75
Wyman and Gregg ...	Genoa, Ottawa Co.....	Waterlime	2	70
Newman and Ford ...	Genoa, Ottawa Co.....	Waterlime	.....	70
Frank Holt	Genoa, Ottawa Co.....	Niagara	1¾	.....
Lyman Chandler	Bellevue, Sandusky Co.	L. Corniferous and Waterlime	1½–2	75
James F. Smith	Bellevue, Sandusky Co.	L. Corniferous and Waterlime	1¼	70
Delzal and Overmeyer	Lima, Allen Co.....	Waterlime	2 1-7	.....
Thomas Cook.....	Harper, Logan Co.....	L. Corniferous	2 2-5	.....
Benj. M. Fisher	Celina, Mercer Co.....	Niagara	3	.....

It will be seen that the amount of wood used by different firms varies considerably, even with the same stone, quarried at the same place. This is owing to the difference of construction of the kilns. Mr. June, for instance, at Fremont, burns one of the most compact and difficult kinds of stone, yet, by the use of a peculiar kiln, he consumes less than

one-half the wood burned by Mr. Quilter or Mr. Gottern. Most of the kilns used in north-western Ohio are of the old style, and once filled and burned, have to be emptied and allowed to cool before more lime can be made. Some have constructed an improved style of kiln, which runs uninterruptedly, thus avoiding the loss of time and heat incident to the old style; but so far as observed, Messrs. June and Son, of Fremont, produce a more evenly burned lime, and with less wood, by using Page's patent draw-kiln.

The lime made from the Lower Corniferous by Mr. Lyman Chandler, of Bellevue, is so mixed in the process with the Waterlime layers below, that its character cannot be certainly stated. It is found, however, to be a very strong lime, although not a pure white. Some of it is greenish-gray; some of it yellowish or buff, like the stone before burning, and much of it is a light ash-color.

In Sandusky county there is no difficulty in obtaining stone for all common uses, in abutments, foundations and walls. Besides the abundant outcropping in the western part of the county, the quarries at Bellevue and Fremont supply the demand in the eastern portion, and considerable is also sent into adjoining towns. The stone and lime forwarded per the Lake Shore and Michigan Southern railroad, in 1870, from Fremont, was 6,401,092 pounds; from Bellevue, 1,215,304 pounds.

For brick and tile, and for pottery, the surface clay, particularly where it is finely laminated with sand, as at Fremont, is well adapted in all parts of the county. An excellent quality of brick is made at Fremont, by puddling these materials closely, the sand furnishing the sharpness and the strength needed, as well as preventing the tendency to warp and crack where clay alone is used. The following list embraces all, or nearly all the establishments of this kind within the county:

AT FREMONT.

O. T. Ball.....Brick.
William Mayford.....Brick.
Charles Giesen.....Brick.
Tistler & Rechtenwaldt.....Brick.
William Parker.....Brick and tile.

AT CLYDE.

Dirlam & Dewey.....Brick.

AT BELLEVUE.

Mr. Gale.....Brick.

AT LINDSAY.

Daniel Monk.....Brick.

AT GREENSPRING.

————? .....Brick.

WELLS AND SPRINGS.

Wells for domestic use are generally obtained in the loose gravel within the drift, or in that sheet of gravel and sand which very often is the lowest part of the drift. As in Ottawa county, such wells are often artesian, and show the source of their water in the mineral impurities it contains. The water of the mineral spring at Greenspring, and of the spring in Sec. 7, Adams, Seneca county, issues from the rock, which, although exposed at no point within six miles, is probably the Niagara limestone. Wells, also, which do not reach the bottom of the drift, are sometimes supplied by slow seepage from the hard-pan, or by penetrating some of the sand or gravel beds contained within the drift. Wells from such higher beds of gravel are common outside the area of the Black Swamp. Within that tract, such beds of gravel are more rarely met with, above that lying on the rock. Some of the artesian wells in the northern part of the county are said to have a distinct saline taste, and must hence be derived from the Salina. The medicinal properties of the sulphureted water at Greenspring, are so marked as to induce the investment of considerable capital in the preparation of a water-cure establishment.

The following chemical analysis of this water by Prof. O. N. Stoddard, of Miami University, Oxford, Ohio, is published by the proprietors. No analysis has yet been made by the Survey:

Sulphate of lime in one gallon	105.41	grains.
Sulphate of magnesia "	36.14	"
Sulphate of iron "	6.53	"
Carbonate of iron "	19.70	"
Carbonate of magnesia "	22.39	"
Bromide of potassa "	16.76	"
Chloride of potassa "	2.48	"
Silica "	6.10	"
Alumina "	.98	"
Total	216.48	"
Carbonic acid gas in one gallon	96.48	cu. in.
Density	1.0258	
Temperature (summer and winter the same)	50°	Fah.

About four miles south-west from Fremont, Mr. John King sunk a drill a few years ago to the depth of six hundred and forty-five feet, with the primary object of petroleum, or at least an artesian overflow. Neither was obtained. No reliable minutes of the boring could be gathered.

Pieces of shale, said to have been brought up from a depth of about four hundred feet, styled "soapstone," have the appearance of the Cincinnati shale. There is, however, now, and has been since the drilling ceased, a discharge of inflammable gas, said to be derived from near the bottom of the well. Water which enters at about a hundred feet, and hence represses it with the force of a column of at least five hundred feet, greatly obstructs the escape of this gas. Were this pressure removed by tubing, the discharge of gas might be abundant enough to admit of use for illuminating purposes.

Geological Survey of Ohio.

GEOLOGICAL MAP OF SENECA COUNTY.

BY

N. H. WINCHELL,

Explanation of Colors

9	Huron Shale Genesse & Portage
8	Hamilton Group
7	Corniferous Limestone
6	Oriskany Sandstone
5	Water Lime
3	Niagara Group

STROBRIDGE & CO. LITH. CIN. O

CHAPTER XXVII.

GEOLOGY OF SENECA COUNTY.

SITUATION AND AREA.

This county is immediately south of Sandusky, and contains fifteen townships, in the form of a rectangular parallelogram. It is bounded east by Huron county, south by Crawford and Wyandot, and west by Hancock and Wood. It is thirty miles long, east and west, and fifteen wide.

NATURAL DRAINAGE.

The Sandusky river, which intersects the county about midway, is the principal stream. Tributaries join it from the east and from the west, and complete the drainage system of the county. Those which enter the Sandusky from the west, have a general course north-east, till they unite with that stream; but those from the west first flow south-westerly, changing when within about five miles of the river, almost at a right angle, from that direction, and flow north-west till they join the Sandusky. This is a peculiarity not confined to this county, and may be due to the halting retreat of the glacier, when throwing down the unmodified drift with which that portion of the county is covered. The divides between these creeks, along their upper waters, would in that case, be the moraine accumulations, which, further west and at lower levels, were not sufficient to divert the drainage from the general course of the main valley. They may be compared to the extended moraines which shut off the St. Mary's and the Wabash rivers from their most direct course to Lake Erie, along their upper waters. These are less extended because the slope westward from the area of the Corniferous limestone is more abrupt.

SURFACE FEATURES.

This county presents more diversity of surface than Sandusky. The north-western part, including the townships of Jackson, Liberty and Pleasant, the northern half of Hopewell, and a small part of Loudon, presents the peculiar features of the lacustrine region, as already defined. The Niagara limestone rises in wide undulations above the surface of the drift, and is as frequently supplied with sandy accumulations and bowlders as in counties further north. The surface of these townships otherwise is very flat. The remainder of the county west of the Sandusky river, as well as the townships of Clinton and Eden on the east, are entirely without such limestone exposures, and the surface, when not broken by drainage valleys, is gently undulating. The eastern part of the county is considerably more elevated than the middle and western, and the surface is characterized at once by longer and more considerable undulations, which have the form very often of ridges, evenly covered by drift, running about north-east and south-west. This greater elevation is due to the greater resistance of the Corniferous limestone to the forces of the glacial epoch, not to upheaval, as many fancy; while the original inequalities in the drift surface have been increased by the erosion of streams. There are still, even in the eastern portion of the county, flat tracts where the drainage is so slow that the washings from the hillsides have leveled up the lower grounds with alluvium and marshy accumulations. In such cases, the elevated drift knolls are gravelly, and show occasional bowlders; but in the level tract which has been filled, no bowlders, or even stones of any kind, can be seen.

The streams are bounded by a flood-plain, and a single terrace. The latter, however, in the case of the smaller streams, is not well defined, especially where the general surface is not flat. The following heights of this terrace, above the summer stage of the river, were ascertained by Locke's level:

Sugar Creek, N. W. ¼ Sec. 27, Pleasant township..... 42 ft. 2 in.
Honey Creek, Sec. 20, Eden township..... 58 feet.
Sandusky river, Sec. 24, Seneca " ..... 63 ft. 3 in.

SOIL AND TIMBER.

The soil, consisting principally of the old drift surface, is what may be termed a gravelly clay, with various local modifications. The principal exceptions are the alluvial flats bordering the streams, where the soil consists largely of a sandy marl, with varying proportions of vegetable matter; the depressions in the old drift surface, which have been slowly filled by peaty soil, and the sandy and stony ridges, in the towns

of Jackson, Liberty and Hopewell. With the exception of the marsh known as Big Spring Prairie, in the south-western part of Big Spring township, the whole county is in a tillable condition. Hence it is settled with a class of intelligent and prosperous farmers, who keep the land generally under constant cultivation.

The original forest, which is now to a great extent removed, embraced the usual varieties of oak, hickory, beech, maple, elm and ash.

GEOLOGICAL STRUCTURE.

The rocks that underlie the county have a general dip toward the east. Hence the Niagara limestone, in the western portion of the county, is succeeded by the higher formations in regular order in traveling east. They are the Water limestone, the Oriskany sandstone, the Lower Corniferous, the Upper Corniferous, the Hamilton shale, and the Huron shale (or the Black slate.) The eastern boundary of the Niagara enters the county a little east of Greenspring, in a south-westerly direction, and, crossing the Sandusky river at Tiffin, it turns westward nearly to the center of Hopewell township, where it turns again south-west, and leaves the county at Adrian. All west of this line is underlain by the Niagara, which is not divided into two belts, as in Sandusky and Ottawa counties. The strip of the Waterlime, which separates it in those counties, probably just indents the northern line of the county in Pleasant township. The outcropping edge of the Upper Corniferous is the only other geological boundary that can be definitely located. Those on either side are so obscured by the drift that their located positions on the map must be regarded as conjectural. In general, however, the Waterlime underlies a strip along the eastern side of the Niagara area, about five miles in width on the north, but widening to nine miles on the south. The Lower Corniferous underlies the western part of Bloom and Scipio townships, and the eastern part of Adams. The Upper Corniferous occupies the most of Thompson and Reed townships, the western portion of Venice, and the eastern portion of Bloom and Scipio. The Hamilton and the Black shale have not been seen in outcrop in the county, but are believed to underlie a small area in the south-eastern portion of the county. The Black shale may be seen in the valley of Slate Run, Norwich township, Huron county.

The *Niagara* shows the following exposures:

IN JACKSON TOWNSHIP.

S.W. ¼ Sec. 36. In a little creek. No dip discoverable.

Sec. 22. A prominent ridge is crossed and slightly excavated by the railroad. The ascent is so gentle the grade rises over it.

N.W. ¼ Sec. 31. Of the Guelph aspect, showing numerous fossils; used for making roads, and for lime.

IN LIBERTY TOWNSHIP.

S.W. ¼ Sec. 4. In the W. Branch of Wolf creek; dip six or eight degrees west.

S.E ¼ Sec. 5.

Sec. 3. Half a mile west of Bettsville. Frequent exposure along the W. Branch of Wolf creek. When observable, the dip is to the west.

Sec. 10. Along the east line of the section, in the form of ridges.

N.E. ¼ Sec. 28.

N.W. ¼ Sec. 2. Horizontal; in the W. Branch of Wolf creek, setting back the water nearly a mile.

N.W. ¼ Sec. 24. Considerably quarried for foundations and abutments of bridges.

S.W. ¼ Sec. 30. By the roadside.

N.E. ¼ Sec. 36. In Wolf creek.

S.W. ¼ Sec. 34.

S.W. ¼ Sec. 31. In thick beds—used by Mr. George King in the construction of his house; dip 5° N.E.

N.W. ¼ Sec. 29.

IN PLEASANT TOWNSHIP.

N.W. ¼ Sec. 19. In the bed of Wolf creek. Dip N.E. Glacial scratches S. 56° W.

N.W. ¼ Sec. 20. In the bed of the river at Fort Seneca, just below the dam, a fine-grained, bluish limestone; has been a little quarried for use on roads. But owing to its hardness and the unfavorable location, it was not regarded suitable. It probably belongs to the Niagara, although the opportunities for examination were too meager to determine certainly.

Center and S.E. ¼ Sec. 28. In thick beds, in Spicer creek.

IN HOPEWELL TOWNSHIP.

N.E. ¼ Sec. 22. Has the aspect of the Guelph, on the land of Henry W. Creeger. Surface exposure.

Sec. 16. Where the road crosses Wolf creek.

In these surface exposures very little opportunity is afforded for ascertaining the lithological characters, or the mineralogical and fossil contents of the formation. The chief exposure of the Niagara within the county is in the Sandusky river, between Tiffin and Fort Seneca.

From Tiffin, descending the Sandusky river, rock shows constantly, to within half a mile of the line between Clinton and Pleasant townships. Throughout the most of this distance the dip of the formation (Niagara) is from five to ten degrees toward the south-west, but with various flexures and undulations in all directions. The thickness of bedding exposed is between fifty and sixty feet. The following minutes on this exposure will show the undulations in the dip of the beds, and

the manner of occurrence of the fossiliferous beds which have by some been regarded as a distinct member of the Upper Silurian, above the Niagara. They make, here, a sudden appearance within the formation, having horizontal continuity with the more usual, hard, gray and thick-bedded Niagara, which contains fewer fossil remains:

Ascending the river along the left bank from the little island on Sec. 29, in Pleasant township, the Niagara is first met within a quarter of a mile, with a dip N.E. 10°, showing glacial furrows S. 44° W.—exposed		3 ft.
A quarter of a mile further south, at a dam for a sawmill, with dip still N.E.—lower exposed		4 ft.
About one-fourth mile above the dam, dip still N.E		6 ft. 6 in.
The rock then begins to dip S.W., and returns—about	—3 ft.	
Dip continuing S.W., returns	—3 ft.	
Dip N.E		2 ft.
Rock visible, no dip discernible for sixty rods.		
Gentle dip S.W. for thirty rods	—2 ft.	
Gentle undulations:—		
N.E		3 ft.
S.W	—3 ft.	
N.E		2 ft. 6 in.
S.W.	—3 ft.	
N.E		3 ft.
Beds dip N.E. nearly a mile, about with the descent of the stream, nearly to the next dam. Exposed, perhaps		4 ft.
Then begins a rapid dip S.W.—seen	—18 ft. 10 in.	
Covered by the dam, not seen, at least	—10 ft.	
Then rises with gentle dip N.W		5 ft.
The beds then appear horizontal about half a mile. This extends to a point two miles from Tiffin, where the rock passes out of sight. It next appears a few rods further up, opposite a brick flouring-mill, in a perpendicular exposure of fourteen feet. Add one-half as dip S.W	—7 ft.	
The river then makes its way over fifteen feet of beds, extending nearly to the first dam north of Tiffin; gentle dip S.W	—15 ft.	
S.W. still (to the bottom of the *Guelph?*)	—8 ft.	
Here that phase appears which has been named the *Guelph*. For a few rods the dip is rapid to the N.E., having much the appearance of unconformability in the bedding. There is a sudden upward flexure of the overlying beds, for this phase here is *under* as much as ten feet of hard gray crystalline Niagara, like that already passed over, containing almost no fossils. This, however, in passing further south, becomes soft, light buff and fossiliferous: below, much broken and confused, or spongy and massive; yet lying horizontally and containing the peculiar fossils of the Guelph. Several small openings in these		

beds for lime-burning reveal *Megalæmus Canadensis*, Hall. *Pleurotomaria* and *Pentamerus*, with species of *Murchisonia* and *Favosites*. The dip then returns S.W. as rapidly as it rose. Add for these fossiliferous beds ..... —15 ft.

Here comes in the Waterlime, showing the fossils *Leperditia alta* and *Atrypa Sulcata?* It is separated from the Niagara, which, just within the limits of the city, has become gray, crystalline and thick-bedded again, without visible fossils, by a bed of two or three inches, which, uniting the lithological characters of the two formations, serves to determine not only the place but the reduced limits of the Salina. Ten rods further south the bluish gray and hard Niagara again bulges upward in a gentle swell, disclosing, below, the light buff and porous layers, while the Waterlime disappears. Continuing so about ten rods, the beds return to the same level, nearly horizontal, but the Waterlime is not shown again till within the city limits, where it has been quarried between the highway and the railroad bridges, and dips S.W.

Total S.W. dip	—87 ft. 10 in.
Total N.E. dip	33 ft.
Actual S.W. dip of the formation	54 ft. 10 in.

From this it appears that the Niagara limestone, especially the uppermost fifty-five feet, is, in general, a gray, crystalline, rather fine-grained, compact or slightly visicular and unfossiliferous mass; and that the fossiliferous parts are rough and visicular, of a light buff color, apt to crumble under the weather, and not horizontally continuous.

The green shale, which, in Sandusky county, represents the *Salina*, has nowhere been seen in Seneca county. The only place within the county where the "junction" of the Niagara and Waterlime has been observed, is in the quarries at Tiffin. Within the corporate limits, a few rods above the swing bridge for the highway crossing, a quarry has been opened in the left bank of the Sandusky, which may be designated *Quarry No.* 1. The Niagara here shows in a broad surface exposure, over which the river spreads, except in its lowest stage. The quarry has not penetrated it, but the overlying Waterlime beds have been stripped off, showing a section of twelve feet in their beds belonging to *phase No.* 3. This lies conformably on the Niagara, so far as can be seen, the separating surface presenting no unusual flexures or irregularities. The only trace of the Salina is in the tendency of the color and texture of the Niagara toward those of the Waterlime, visible through its last three or four inches. It is bluish-drab, porous, crystalline, with some indistinct, greenish lines and spots. It contains much calcite and some galena. From this character it passes immediately into a bluish-gray,

crystalline rock, in thick, firm beds, with spots of purple, heavy and slightly porous, the cavities being nearly all filled with calcite.

The principal exposures of the *Waterlime* are in the quarries at Tiffin.

Section of Quarry No. 1, in descending order.

No. 1.	Waterlime in thin, drab beds, like the Fremont quarries of June and Quilter. Exposed	12 ft.
No. 2.	Porous, bluish-drab, with greenish streaks, containing much calcite and some galena	3 in.
No. 3.	Firm, gray Niagara, in thick beds. Exposed	1 ft.

Quarry No. 2 is located a quarter of a mile above the last, on the opposite or right bank of the river, and is known as the *City Quarry.* The dip is here S. W. six or eight degrees. Supposing the dip is uniform between Quarries Nos. 1 and 2, there must be an unseen interval of twenty-five or thirty feet of the formation separating them.

Descending Section of the Waterlime at Quarry No. 2, Tiffin.

No. 1.	Very compact; fine-grained; in beds of six to thirty inches. The fracture is a brownish-drab, and weathers light drab; sometimes porous or brecciated	8 ft. 4 in.
No. 2.	Thin-bedded; more earthy; rough in patches, and feeling like a fine-grained sandstone. The general facies is like Nos. 3 and 7..	10 in.
No. 3.	Very compact, fine-grained beds of one or two inches; broken; irregular; separated with bituminous films which weather first blue, then chocolate. The fracture is a brownish-drab, and weathers light drab. It is sometimes porous or slightly brecciated. When fine-grained and compact it shows acicular cavities	2 ft. 2 in.
No. 4.	Same as the last, except the beds are even	1 ft.
No. 5.	Very compact; fine-grained; gray; crystalline; with occasional amorphous cavities. In one bed	1 ft. 2 in.
No. 6.	Very compact and fine-grained; in even beds of one to two inches. The separating bituminous films weather blue, turning to chocolate; the brownish-drab, fractured surface weathers light drab; in some places with fine acicular cavities	2 ft. 3 in.
No. 7.	Very compact and fine-grained; in beds of one to two inches; in broken, irregular and lenticular; separated by bituminous films, which weather blue and then chocolate; fracture brownish-drab; weathering light drab; in some places with fine acicular cavities. This being the lowest exposed, it has been stripped of the overlying beds for the space of several rods. The exposed upper surface of the bedding is very uneven, being thrown into curious mound-like elevations of two to six or eight inches, and a foot to three feet across, which do not show any system of arrangement. Considerable bituminous	

matter is disseminated through them, not included in the texture of the rock, which is very hard and crystalline, but in thin films between the beds, or in irregular deposits within the little mounds, or about their peripheries. The laminations which form these mounds are thinner than the regular bedding, and are sometimes not more than half an inch thick. They never show concave surfaces upward (hence the mounds are not concretions,) but variously modify and fit to each other like a quantity of semi-fused and inverted plates or watch-glasses, the bituminous matter acting as a cement. Exposed... 2 ft.

Total exposed..... 17 ft. 9 in.

The characteristic fossil, *Leperditia alta*, may be seen in nearly all parts of this section, but it was especially noted in Nos. 3 and 7. This rock is all hard and crystalline, but with a fine grain. No. 3, without careful examination, might be mistaken for Niagara, if seen alone. When broken into fragments for roads, the color of the pile, weathered a few months, is a pleasant, bluish-gray. Yet on close examination the blue tint vanishes, and the stone shows a drab, a dark or brownish drab, a black, and a bluish-gray, (the last two only on the lines of the bedding,) depending on the fracture or surface examined.

The river just in the southern limits of the city is flowing east. The rock can be followed along the same bank of the river eighteen or twenty rods from the foregoing quarry, and has an irregular surface exposure throughout that distance, with a continuous dip south-west. The rock then follows the bluff, which strikes across a patch of river bottom, and is not seen again until a mile further up the river. It is here quarried and burned into lime. The dip is in the opposite direction, that is, toward the north. This is quarry No. 3.

Descending Section of the Waterlime, Quarry No. 3, Tiffin, Seneca County, O.

No. 1.	Soft; drab; slightly porous	1 foot.
No. 2.	Hard and close-grained; gray and drab	1 ft. 2 in.
No. 3.	Brecciated, (like Put-in-Bay Island,) with hard and soft; drab and dark drab; sometimes cavernous, with considerable calcite, and porous	4 feet.
No. 4.	In one bed. Hard; gray; porous, with celestine	2 feet.
No. 5.	In one bed. Very porous; soft; drab	1 foot.
No. 6.	Hard; porous; dark drab	1 foot.
No. 7.	Soft; drab; veined tortuously with darker drab; in one bed	2 ft. 4 in.
No. 8.	Porous; gray and drab (mixed); with coarse but firm texture	1 ft. 3 in.
No. 9.	Hard, drab beds, but porous	2 feet.
No. 10.	Coarse, drab beds; porous; rather soft under the hammer	12 feet.
	Total	27 ft. 9 in.

This rock is quite different in most of its external aspects from that described in the last two sections, and it probably overlies them. It is much more loose-grained and porous, and is almost without bituminous films. The beds are generally six to twelve inches, but sometimes three feet in thickness. It has more constantly the typical drab color of the Waterlime, and it shows, besides the *Leperditia alta*, another bivalve like *Atrypa sulcata*, and a handsome species of *Orthis*, also a coarse Favositoid coral, all of which are often seen in the Waterlime.

In the S.E. ¼ Sec. 22, Hopewell township, Mr. Henry W. Creeger quarries the Waterlime in the bed of Wolf creek; dip south six or eight degrees.

The Waterlime appears in thin, drab beds, at the bridge over the Sandusky, N.E. ¼ Sec. 23, Seneca township, with undulating dip.

S.E. ¼ Sec. 29, Clinton township, where the road crosses Rock creek, the Waterlime is exposed, having the features of No. 8, of Quarry No. 3, at Tiffin.

The *Oriskany Sandstone* is nowhere exposed in this county, but its line of outcrop probably passes through Adams, Clinton and Eden townships.

The *Lower Corniferous* has been observed in the following places:

S.W. ¼ Sec. 1, Eden township. Along the bed of a little creek tributary to Rock creek, a magnesian, buff, granular limestone is exposed. It has no fossils, so far as can be seen in the meager outcrops. It is also seen in the banks along the creek, on the farm of Mr. Ferguson. It was formerly quarried to a limited extent, and used for rough walls. It is rather soft at first, but is said to become harder when the water is dried out. No dip is discoverable.

N.W. ¼ Sec. 17, Bloom township. In the bed of Honey creek, near Mr. Philip Heilman's residence, the same rock may be seen; dip uncertain, but it appears east and south-east.

N.W. ¼ Sec. 20, Bloom township. In the right bank of Silver creek there is an exposure of higher beds of the Lower Corniferous, as follows, from above:

No. 1.	In beds of two to six inches; buff and dark buff; magnesian; very slightly fossiliferous; some hard and crystalline, some soft and spongy. These edges do not appear slaty. They have been long weathered, and lie loose. This is near the junction of the Lower and the Upper Corniferous	10 ft.
No. 2.	Magnesian; rather hard; crystalline; non-fossiliferous; buff when dry; fine-grained; banded with darker buff, or with brown when in thicker beds. Beds ¼ in. to 2 in. Their edges appear slaty	2 ft.
	Total	12 ft.

Lying nearly horizontal five or six rods, at the east end of the bluff, the beds dip east and disappear. A little west of this exposure the magnesian, non-fossiliferous, thick-bedded characters of the Lower Corniferous may be seen in the bed of the creek. Eighteen or twenty rods to the east, the features and fossils of the Upper Corniferous appear in an old quarry by the road-side, where the dip is E.N.E.

S.W. ¼ Sec. 3, Scipio township. Along the channel of Sugar creek, on land of Enoch Frey, a stone is exposed which appears like Lower Corniferous. It is soft and coarse-grained, without visible fossils. A pond which has precipitous banks, and is said to sometimes become dry, located near this place, is probably caused by subterranean disturbance and erosion.

The quarry of Mr. David Wyatt, N.W. ¼ Sec. 1, Scipio township, is in a thin-bedded, buff stone, which has no tendency to blue, without fossils, and included within the Lower Corniferous.

The Lower Corniferous is also exposed S.E. ¼ Sec. 34, Adams township, along the public road.

N.E. ¼ Sec. 26, Eden township. A fine-grained argillaceous, gray rock, weathering buff, without visible fossils, appears in the road. It seems apt to break into angular pieces three or four inches across. It is rather hard. It is probably included within the Lower Corniferous.

The opportunities for observing the lower portion of the Corniferous within the county are not sufficient to warrant a general section and description.

The *Upper Corniferous*, owing to its greater hardness and toughness, was not so generally destroyed by the ice and water of the glacial epoch, and now may be more frequently seen, thinly covered with coarse drift, occupying the highest parts of the county, and forming the main watershed. The coarseness of the drift on these higher tracts is owing to the washings by rains and freshets since the close of the glacial epoch. It is an unassorted hardpan, and sometimes covers glacial *striæ* in the rock below.

This part of the Corniferous is exposed in the following places within the county. It furnishes a very useful building stone, and is extensively used for all walls, foundations, and some buildings:

IN THOMPSON TOWNSHIP.

N.W. ¼ Sec. 20. It closely underlies the most of the section. The drift being thin, the soil sometimes shows fragments. A quarry is owned by Mr. John Paine.

S. W. ¼ Sec. 16. Mr. George Good's quarry; beds horizontal; in the midst of a field in fine cultivation, with a surface gently undulating; drift at the quarry eight inches, but rapidly thickening further away.

S. W. ¼ Sec. 16. Samuel Rogers's quarry exposes about eight feet perpendicular; beds about horizontal.

S. W. ¼ Sec. 14. Reuben Hartman's quarry exposes about eight feet of blue thin beds, which seem to have been shattered, falling toward the west, the firm beds having a slight dip toward the north-east. Large, handsome flagging is obtained at this quarry.

N. E. ¼ Sec. 2. Benjamin Bunn's quarry. There are here about three feet of drift over the rock. The beds are exposed about six feet perpendicular. Dip not observed, although there is a falling away by fracture toward the west.

S. W. ¼ Sec. 1. Charles Smith's quarry faces west. Indeed the same is true of Hartman's and of Bunn's. Mr. Rogers's is an irregular opening, facing mostly north and west. Mr. Good's faces north and east.

S. E. ¼ Sec. 1. In the edge of Huron county, Mr. George Sheffield has a quarry in horizontal beds; gravelly soil eighteen inches.

S. E. ¼ Sec. 1. Quarry of William Clemens.

N. E. ¼ Sec. 21. Quarry of Joseph Shirk. This consists of a mass of shattered and dislodged beds, from which, however, good stone is taken. In one place, a mass showing a perpendicular thickness of five feet, is twisted away from its original position, the planes of jointing indicating where it ought to lie. It is removed two feet from its natural place. The projection beyond the face of the other beds tapers; in the distance of about fifteen feet, to a few inches, and is hid by debris.

N. E. ¼ Sec. 15. Quarry of John M. Krauss.

N. E. ¼ Sec. 29. Quarry of Mrs. Joseph Hoover.

N. E. ¼ Sec. 10. Quarry of Isaac Carn.

N. W. ¼ Sec. 11. Quarry of Tunis Wygart.

N. W. ¼ Sec. 2. Quarry of heirs of Grimes.

Many others also have small openings in the rock in this township. They are nearly all in the midst of cultivated fields, and there is a remarkable absence of bowlders, although the rock is seen sometimes projecting above the surface. There are a few bowlders, but they are such as belong in the drift, and have been dug out by the erosion of streams, or by man. They are not thick about rocky outcrops, as in the lacustrine region.

IN BLOOM TOWNSHIP.

N. W. ¼ Sec. 11. Lewis Fisher has an extensive quarry in the Upper Corniferous, in the valley of a little tributary to Honey creek. About fifteen feet of bedding are exposed, lying nearly horizontal. The lowest beds are about eighteen inches in thickness, and softer, yet of a blue color like the rest. In working Mr. Fisher's quarry it has become necessary to remove about ten feet of hardpan drift.

N. E. ¼ Sec. 10. Jacob Detweiller's quarry is also an extensive opening, and exposes beds a few feet lower than Mr. Fisher's. The lowest seems to be lighter colored, and must be near the bottom of the Upper Corniferous. A stream disappears in this quarry in time of freshet.

S. W. ¼ Sec. 3. Henry Determan's quarry is located in the valley of Honey creek.

N. E. ¼ Sec. 20. Along the banks of Silver creek there is considerable exposure o

the Upper Corniferous, and it is extensively wrought by Abram Kagay. The beds here have a continuous dip E. S. E., affording opportunity for the following section:

Descending Section of the Upper Corniferous, at Abram Kagay's, Sec. 20, Bloom township, Seneca county.

No. 1. Fossiliferous beds with chert which weathers white; thin-bedded; of a bluish-gray color ..... 7 feet.

No. 2. Thin, flaggy, lenticular beds; fossiliferous; drab-buff color; hard, brittle, and sometimes with vermicular impressions ..... 4 feet.

[NOTE.—No. 2 would probably be thicker bedded and bluish if freshly exposed.]

No. 3. The same as No. 2, but in more even beds ..... 28 feet.

Upper Corniferous exposed ..... 39 feet.

N. W. ¼ Sec. 29. Noah Einsel has a handsome quarry, in beds which dip E. N. E.

N. W. ¼ Sec. 20. Reed township. The Upper Corniferous is quarried by Mr. Armstrong.

THE DRIFT.

Throughout this county, this deposit lies as it was left by the glacier. The mass of it is an unassorted hardpan, but it shows locally the glacial stratification incident to streams of water arising from the dissolution of the ice. Such cases of stratification are most common in the great valleys, where the waters necessarily accumulated. They are by no means common, nor uniform in their location in the drift vertically. In some cases, the stratification rises nearly or quite to the surface, or prevails to the depth of thirty or forty feet. In others, it embraces one or more beds of hardpan, which have irregular outlines. In Sec. 20, Eden township, the banks of Honey creek were particularly noted, and may be described as follows:

No. 1. This is imperfectly exposed, but wherever seen is unassorted hardpan, with considerable gravel. It forms the soil of the county, and is of a brownish yellow color ..... 25 feet.

No. 2. Is blue, and composed of alternating beds of compacted hardpan, containing waterworn and scratched pebbles of all kinds and sizes, apparently unassorted and unstratified, and beds of coarse sand, extremely fine sand, and coarse gravel. From the sand and gravel layers issue springs of ferriferous water. The sand layers graduate sometimes into impervious clay-like beds, and can hardly be called sand. The lowest seen in No. 2 is a layer of eighteen inches, at least, of clean sand ..... 30 feet.

No. 3. Talus of rounded pebbles and stones, mostly limestone, and frequently stained with iron oxyd ..... 3 feet.

The thickness of the drift cannot be stated with certainty. At Attica,

in the township of Venice, wells penetrate it to the depth of sixty feet without striking the rock. This is the highest point within the county, and the general surface is rolling.

MATERIAL RESOURCES.

BUILDING STONE.

Next to the products of the soil, the most important resources of Seneca county consist in the products of the quarries. Throughout most of the county there is no difficulty in obtaining good building stone, although the best quarries are situated a little unfavorably for the townships of Loudon, Big Spring, Seneca, Eden, Pleasant, Venice and Reed. The quarries at Tiffin furnish stone throughout a radius of many miles in all directions, while those in Bloom township supply a great tract of country south and east. The quarries in Thompson township, although located in the Upper Corniferous, and affording one of the best qualities of stone in north-western Ohio, and favorably exposed for working, are less developed than similar openings in Bloom township. This is doubtless due to the superior advantages of quarries further north, and at Bellevue, in Sandusky county, for reaching market and for shipment by railroad.

LIME.

For *lime* the Niagara and Waterlime formations are chiefly used. They are more easily quarried and more cheaply burned than the Upper Corniferous. Both are burned at Tiffin, but the kilns are rude, and the expense of burning is greater than where the improved kiln is employed.

CLAY.

Clay for brick and red pottery is found of suitable quality in all parts of the county. Many establishments for the manufacture of brick employ the surface of the ordinary hardpan, including even the soil. Others reject the immediate surface, which contains roots and turf, and burn the hardpan from the depth of a foot or two. This material, although liable to contain pebbles of limestone, which injure the manufactured article, generally has it in so small quantity, and in so comminuted a state, as to require no other flux for the silica; and the tile, brick and pottery made in this way are suitable for all purposes where no great degree of heat is required. Mr. J. H. Zahm, of Tiffin, after many careful experiments, has succeeded in making a good quality of hydraulic cement, by mixing the finest of the drift clay, in proper parts, with ordinary carbonate of

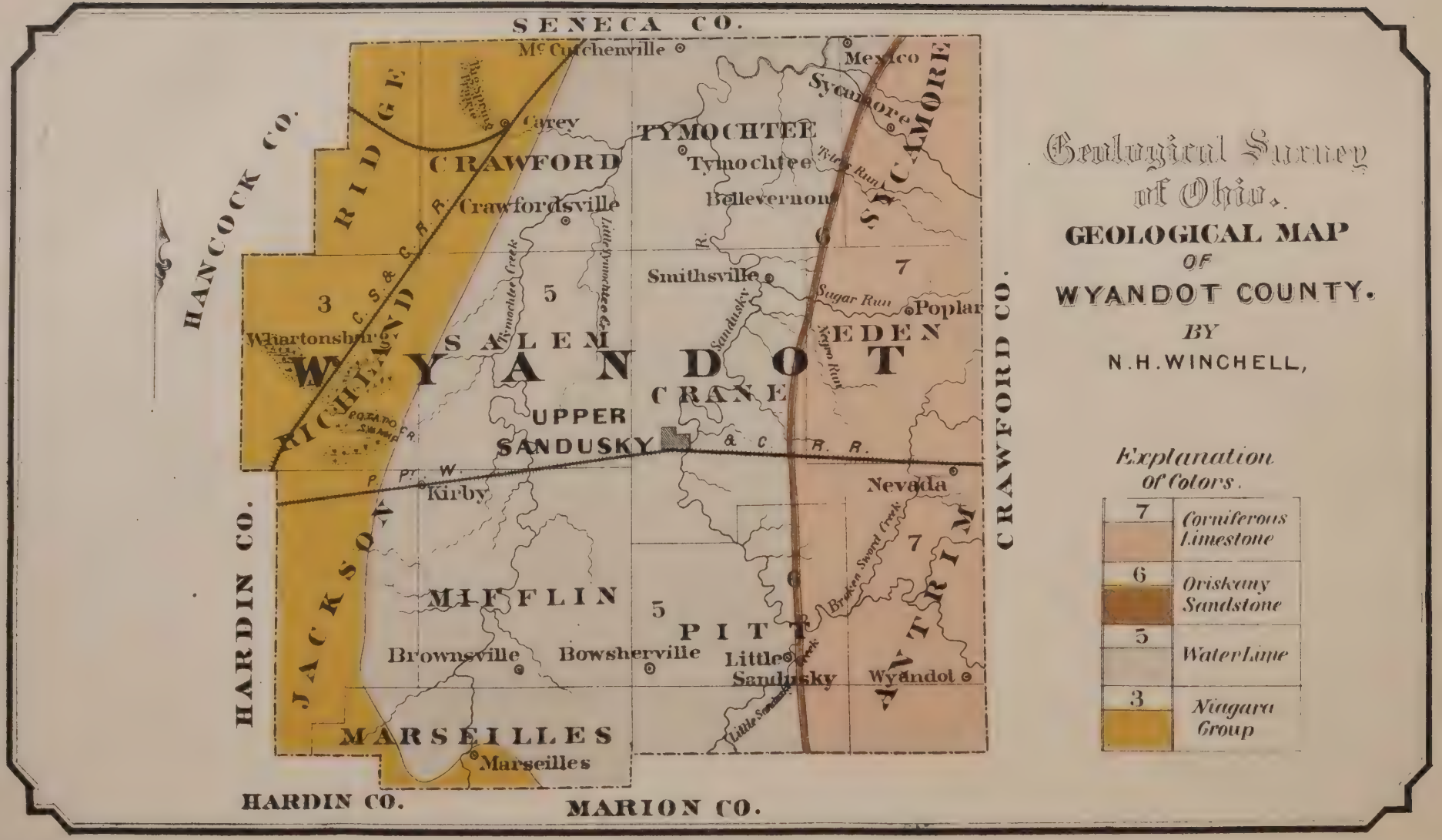
lime or tufa. He has also produced from the drift clay near Tiffin, by making proper selections, a very fine pottery, some of which cannot be distinguished from the *terra cotta* ware used for ornaments and statues. It has a very close, vitreous fracture, a smooth surface, and a dark-red or amber color. From the drift clay near Tiffin, Mr. Henry W. Creeger also obtains a fine material for pottery, and for glazing with salt.

BOG-IRON ORE.

Before the development of the Lake Superior and Missouri iron mines, one of the principal sources of iron in the north-west was the bog ore deposits which are scattered over much of the country. In north-western Ohio the numerous furnaces which were employed on these deposits along the south shore of Lake Erie, and in counties further south and west, rendered bog ore an important item of mineral wealth. It produces an iron known as *cold short*, owing to the presence of phosphorus, which cannot be used for wire or for sheet iron, but is valuable for castings. On the contrary, iron from the ores which contain sulphur as an impurity, or silicon, is friable or brittle while hot, and is distinguished as *red short*. When these two qualities occur in close proximity, or in circumstances favorable for transportation, they may be mixed in the process of smelting, and the resulting iron is greatly improved. The Lake Superior ores, which are the only ones smelted in the furnaces of north-western Ohio, are nearly or quite free from sulphur, and hence at the present time the bog ores possess but little commercial value. It will be only in connection with the sulphur ores of the Coal Measures, in the south-eastern part of the State, that the bog ores can be made of any mineral value.

In Seneca county bog ore occurs in a number of places. It is usually not in quantities sufficient to invite expenditure of capital, and, in the absence of abundant fuel, it will probably never be of any economical value. It was met with on the farm of William B. Stanley, about two miles south-east of Tiffin, where it underlies a peat bog covering irregularly perhaps fifteen or twenty acres.

It also occurs on the land of Mr. Foght, S.E. ¼ Sec. 27, Seneca township. It has been taken out here in large blocks, roughly cut while wet, and set up for back walls in rude fire-places. On being exposed to the air, or especially to fire, it becomes cemented and very hard. There is also a deposit in Sec. 11, Clinton township, exactly on the south line of the Seneca Indian Reservation.



Geological Survey of Ohio.

GEOLOGICAL MAP OF WYANDOT COUNTY.

BY

N. H. WINCHELL,

Explanation of Colors.

7	*Corniferous Limestone*
6	*Oriskany Sandstone*
5	*Water Lime*
3	*Niagara Group*

STROBRIDGE & CO. LITH CIN. O.

CHAPTER XXVIII.

GEOLOGY OF WYANDOT COUNTY.

SITUATION AND AREA.

This county, which lies south of Seneca, is bounded east by Crawford, south by Marion and Hardin, and west by Hardin and Hancock, containing eight square miles more than eleven townships.

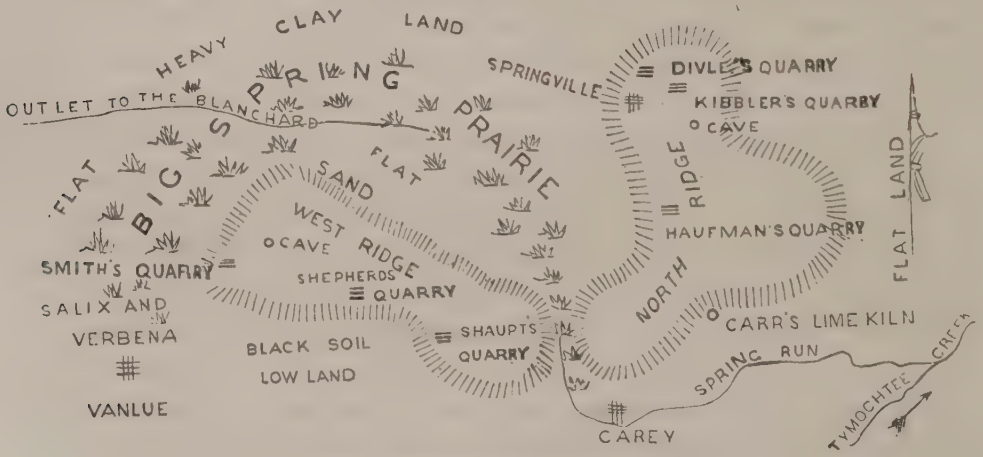
NATURAL DRAINAGE.

Being near the great water-shed of the state, just on its northern slope, it contains no large streams. The Tymochtee creek, with its tributaries, and the headwaters of the Sandusky river, comprising the Little Sandusky and the Broken Sword creeks, and the small stream known as Sycamore creek, Tyler's run, Sugar run, Negro run and Rock run, are the drainage system of the county. Their general course is due north, except that the eastern tributaries of the Sandusky, and perhaps for the same reason as in Seneca county, have a direction westerly or southwesterly, until they descend upon the area of the Waterlime, and are well within the drainage valley of the Sandusky. The Tymochtee creek, throughout the most of its course in Wyandot county, is a slow stream and has a clay bottom. Its valley is as wide and its banks as high as those of the Sandusky itself, although less water actually passes down its channel. The Sandusky, on the contrary, more frequently runs on a rock bottom, and its current is more rapid. It affords occasional water-power privileges. The same is true of the small creeks entering it from the east.

SURFACE FEATURES.

The topography of this county is quite simple. The western half is gently undulating or flat. The excavated valley of the Tymochtee creek, which is usually about a hundred rods wide, and rarely exceeds two

tain the thickness of this black muck, but no result was obtained other than the fact that while it exceeds eight feet in some places, it is usually but four or five. It is thin about the margin of the marsh, and seems to be generally underlain by a tough, blue clay, often so calcareous as to constitute a marl. This blue clay is sometimes itself overlain by a bed of quicksand. Within the muck the horns of elk are said to have been found, and logs several feet in diameter. Along the south margin of the prairie, within the bow, there is considerable sand, as if the deposit of a lake shore. Within the bow of the prairie there is also considerable flat land not marshy, the surface rising very gently toward the south for the distance of nearly a mile, when the west ridge rises suddenly to the height of nearly fifty feet. The prairie is crossed by three public roads. These are constructed by throwing together the dirt from two parallel ditches, on which is placed first corduroy, and afterward, when repairs are needed, stone is hauled from the ridges, giving the road a rough macadamizing. Many months in the year the prairie is covered with water, and it is only in the driest months that cattle venture on it for grazing. Within it are sometimes little undulations or hillocks, on which grow bunches of shrubs and large herbs. The annexed figure shows the position of the prairie and the shape of the ridges.



MAP OF BIG SPRING PRAIRIE.

The rock here exposed has been found to contain characteristic Niagara fossils only in the North Ridge. There are no perpendicular sections of the bedding, except in small quarries on the slopes of the ridges near their bases. In these openings the stone appears very different from that seen in bare places higher up the ridges and on their summits, and the dip is uniformly toward the low ground, whatever the position of the quarry.

The quarry of Mr. Samuel Shaupt, situated on the western slope of the west ridge, about three miles from Carey, shows the rock dipping about fifteen or eighteen degrees toward the south-west, that is, toward the nearest low ground. It is in thin, fragile beds, of a light drab or buff color, porous, and soft under the hammer, showing no distinguishable fossils.

In the quarry of Mr. Thomas Shepherd, N.E. ¼ Sec. 11, Ridge township, about a mile north-west of Mr. Shaupt's, the following section is exposed from above; dip six or eight degrees S.W.

No. 1.	Beds thin, and so carious they can hardly be lifted; in even sheets of a buff color, sometimes reduced to sand by the weather.....	10 in.
No. 2.	Beds three to eight inches; vesicular; of a buff color; easily worked.....	4 ft.
No. 3.	Irregularly bedded; lenticular or massive; buff color; carious; with traces of fossils.....	2 ft.
	Total	6 ft. 10 in.

Mr. F. J. Werlow's quarry, N.E. ¼ Sec. 16, Crawford, is in the same kind of stone, but it is so far removed from the ridge that the beds have not been tilted by it. They lie horizontal, or with a very slight inclination S.W. The rock is here very near the surface. The same is true at Carey, where it is sometimes reached in digging post-holes for fences.

The quarry of Mr. Jonas Huffman is in the west slope of the north ridge, situated N.W ¼ Sec. 4, Crawford township, and shows the following descending section. Dip toward the west 10°. The rock here is overlain by about two feet of drift and loose fragments.

No. 1.	Thin beds; light drab; weathering buff; porous like a very fine sponge. Beds two to four inches without fossils	2 ft.
No. 2.	Confused and lenticular in the bedding, with larger pores or cavities, sometimes filled with calcite; fossiliferous, showing two species of bivalves, Cyathophylloids and Favositoids.....	2 ft.
No. 3.	Hard; close-grained; light drab; beds four to eight inches. The close-grained texture sometimes occurs irregularly through the mass, and has a bluish tint	2 ft.

Mr. William Divle's quarry, at Springville, in Seneca county, is near the northern extremity of the north ridge, and on the western slope. The stone is the same as Mr. Shaupt's and Mr. Shepherd's on the west ridge. It contains no fossils. Opened about four feet. Dip W.

Mr. Peter Kibbler's quarry, also at Springville, affords a slight exposure of the same kind of stone, with a gentle dip W., *i. e.* toward the prairie. The stone here seems a little more firm, but is generally porous,

with fine cavities; fossils wanting or so absorbed as to be undistinguishable. The color is a light drab, varying to buff, and also to gray, especially when thrown out in piles. The stone is not handsome, the beds being uneven and containing some white chert.

At Mr. David Smith's quarry, N. E. ¼ Sec. 3, Amanda, Hancock county, the stone is buff, porous, and in thin beds about two inches in thickness. No visible fossils except vernicular markings. This quarry is situated on the west flank of the west ridge, and the beds dip S.W. Exposed, 4 ft. 10 in.

Exposures on the north ridge, in the eastern part of Sec. 4, Crawford township, show a dip easterly, with the slope of the ground.

Stone thrown out from these quarries becomes a light buff, sometimes almost white, under the weather, and although not of a durable quality, it has been considerably used in ordinary walls and foundations.

In passing over the ridges, which are occupied by good farms, stones are often seen gathered from the fields and deposited in piles or in the corners of the fences, or laid up in walls. They consist of fragments from the underlying rock, and of northern bowlders, the former greatly predominating. Along the road the rock is frequently seen bare, and as already remarked, it is different, lithologically, from that seen in the foregoing quarries. It is most frequently a dark drab or brown, hard, crystalline rock, apparently in a rough, massive condition, containing cavities sometimes two or three inches in diameter. It nowhere appears in even beds. It is rarely vesicular like the stone seen in the quarries described, but contains large cavities, irregularly scattered through it. The color is sometimes a bluish drab, and it not unfrequently shows obscure traces of fossil remains. Surface fragments scattered over the eastern projection of the north ridge afford such fossils as *Pentamerus (galeatus?) Megalamus Canadensis*, Hall, *Platyostoma Niagarense*, *Favosites Niagarensis*, and a species of Cyathophylloid coral, with characters sufficiently definite for identification. [The following were identified with various degrees of certainty: *Pleurotomaria Elora*, Bill? *Murchisonia (bellicincta*, Hall? only an impression,) *Atrypa nodostriata?* (impression) *Trimarella*, sp? (common as casts), *Pentamerus oblongus* (cast). Impression of a handsome crinoid calyx. *Cyclonema sp? Favosites*, (with fine cells), an Orthoceratite and *Atrypa sulcata?* The last is very common, and occurs almost entirely as casts. Another bivalve, which appears like *Atrypa reticularis*, is very common as impressions. These occur sometimes in rock otherwise compact and solid, or they may be so numerous as to make the rock porous and loose, the interior of the shell being entirely wanting.]

The surface fragments furnishing these fossils are, however, more vesicular and lighter colored than the stone usually seen scattered over the surface of the ridges. They have the lithological characters of that phase of the Niagara seen in the Sandusky river at Tiffin, Seneca county, and at Genoa, in Ottawa county. In the N. E. ¼ Sec. 32, Crawford township, a ridge may be seen of the same kind of stone as those north of Carey, running north and south, visible about one-half mile, slightly exposed on land of Joseph Paul.

It would seem as if the conditions of the ocean's bed, in which the Niagara was formed, were not uniform. While regular strata were being deposited in a wide area, including portions of Seneca and Hancock counties, without disturbance or contortions, a concretionary and crystallizing force sprang into operation in the N. W. corner of Wyandot county, which, working from below, caused the even beds of deposition to swell upward or over the growing mass or masses. In some cases, it aided in the preservation of fossil remains; in others, it hastened their absorption into the mass of the rock. This is a peculiarity of rock formation not confined to the Niagara, but is displayed conspicuously in the Waterlimestone above, and it has been seen in the Lower Corniferous. When the lapse of time brings such hardened masses into contact with the erosions of ice and water, they cause the prominent features of the landscape, by the removal of the more destructible parts about them. Such may be the explanation of the remarkable ridges about Carey, the even, friable beds seen in the quarries about their flanks having once been continuous over their summits, but, unable to resist the forces of the glacial epoch, were denuded down to the more enduring rock.

Within these ridges are several caves, the entrances to which are small and have been accidentally discovered, sometimes by men plowing in the field. One particularly, on Mr. Charles Zook's farm, N. W. ¼ Sec. 2, Ridge township, is described as having a perpendicular descent of sixty-five feet, to a stream of water which is also very deep, and separates one apartment by a narrow passage from another. The entrance is about five feet across, and the sides are of rock.

The Niagara in the south-west corner of the county, rises rapidly in the same way from below the Waterlime which lies to the north, the dip being N. E., and to the amount of twenty-five degrees, along sections 18 and 13, near the county line. It here appears as a thick-bedded, gray, and crystalline limestone. It also shows in the Tymochtee creek, at the village of Marseilles, in a characteristic surface exposure. About five feet of thick, hard beds may be seen along the creek, lying nearly horizontal, or with a very slight dip S. S. W. It is slightly porous and fos-

siliferous. It is sometimes blotched with blue and drab. These are the beds that rise so rapidly about a mile further south, forming a little ridge or brow of prominent land facing north. On this brow is situated the residence of Mr. Socrates Hartle. The rock is shown in the excavation for his cellar about the center of Sec. 13, (west of the village,) in Marseilles township ; also, in a ditch by the roadside, in Sec. 18, about sixty rods east of Mr. Hartle's house, where the rapidity of the current of water has cleaned off the smoothed and striated rock in a handsome exposure. A little stream, locally known as Little Tymochtee creek, makes eastward along the north side of this brow of land, and on Sec. 13, less than a quarter of a mile north of Mr. Hartle's house, and perhaps thirty feet *below* the Niagara outcrop near it, the blue, slaty beds of the Waterlime may be seen in this creek.

In the S. E. ¼ Sec. 13, (S. W. of the village,) Marseilles township, Mr. M. V. Toner has a quarry in the Niagara. The beds here are three to six inches in thickness. The stone is rather firm, though somewhat porous. It is used for quicklime and for general building purposes.

On the N. W. ¼ of the same section, land of Miss Addie Terry, the Niagara has been a little worked for quicklime ; dip N.

S. E. ¼ Sec. 11, (W. of the village,) Marseilles township, D. Heckathorn burns lime from the Niagara ; dip north ; beds about four inches. Within forty rods north of Mr. Heckathorn's quarry, the Waterlime appears in the Little Tymochtee creek.

N.E. ¼ Sec. 11, (W. of the village,) Marseilles township, H. H. Carey burns lime and supplies building stone from the Niagara ; beds three to five inches ; dip E. ; exposed eighteen inches.

N.E. ¼ Sec. 9, (W. of village,) Marseilles township, Mr. Charles Norris burns lime from the Niagara. The creek here furnishes considerable exposure.

S.E. ¼ Sec. 11, (W. of the village,) Marseilles township, Michael Keckler has a small opening in the Niagara.

The *Salina* was nowhere observed in Wyandot county.

The *Waterlime formation*, which in counties further north presents three distinct, general lithological characters, in Wyandot county is mainly reduced to one. That aspect of the Waterlime designated " phase No. 3 " on a former page, passes, with the addition of much bituminous matter, into a thin-bedded, even slaty, condition, which, first black, weathers blue on the sides of the bedding, or lastly a chocolate color, while the fractured edge is a very dark drab. Throughout the county it is known in this condition as " blue slate." When the bituminous matter is more

evenly distributed through the rock, instead of being confined to the thin partings, the beds are thicker, and of a blue color.

The principal outcrop of the Waterlime within the county is along the left bank of the Tymochtee creek, in sections 27 and 34, in Crawford township. The banks of the creek expose perpendicular sections of four to eight feet of these thin beds. The dip being continuously toward the south-west, a connected section of 84 feet 10 inches may be made out as follows, in descending order:

Section of the Waterlime in the banks of the Tymochtee Creek, Secs. 27 and 34, Crawford, Wyandot County.

No. 1.	Thin, (1 inch) dark-drab, brittle beds	1 ft.	
No. 2.	Beds two to three inches; lenticular; light-drab; weathering ashen; with *Leperditia alta*	2 ft.	6 in.
No. 3	Light-drab beds, weathering ashen; two to six inches	2 ft.	
No. 4.	Drab, slaty beds, with frequent bituminous films; deep fracture sometimes blue-drab; beds half inch thick; blue color rarely seen; the equivalent of the stone of Carey's quarry	24 ft.	
No. 5.	Beds two to four inches; drab; compact and fine-grained; showing no blue; like the stone in June's quarry, Fremont	15 ft.	
No. 6.	Beds thin (1 to 4 inches); drab; regular; fine-grained; compact; showing no blue or chocolate; on a deep fracture bluish drab, or blue	12 ft.	
No. 7.	Drab, slaty beds; separated by brown bituminous films; above the beds are thicker but more lenticular	10 ft.	
No. 8.	Drab; fine-grained; slaty with bituminous films that weather blue. Some beds are four inches, but without long horizontal continuance	4 ft.	
No. 9.	Earthy, slaty beds, weathering blue and chocolate on the sides, which are coated with bituminous films. The broken edges of the bedding are dark-drab, sometimes with irregular spots of light-blue	10 ft.	
No. 10.	Vesicular and carious; coarse, ungainly; of a dark-drab color; with traces of fossils; mostly hid from observation, but apparently without horizontal continuance	1 ft.	6 in.
No. 11.	One bed; fine-grained; drab		4 in.
No. 12.	Beds one-fourth inch; slaty; drab; with blue films	1 ft.	
No. 13.	Drab, lenticular beds of two inches; sometimes bulging and then harder, or in regular courses of two to four inches	1 ft.	6 in.
	Total exposed	84 ft.	10 in.

Nos. 7, 8 and 9 have very much the same general lithological *facies*, and may be appropriately included in the general designation of *Tymochtee Slate*. The beds are homogeneous, tough, thin, sometimes having so much bituminous matter as to appear like the great *Black Slate*. The

thinnest beds are, however, streaked with alternations of dark drab, and a bituminous brown. When wet the brown is almost black, but when dry and weathered it assumes a blue color, and if long weathered it becomes chocolate. There are among these occasional patches of thicker, even, drab beds, which finally become so persistent, upward, as to require a special designation.

Mr. Donald M. Carey has a quarry in these thin, blue beds (Nos. 2, 3 and 4) on Sec. 27, which has acquired considerable notoriety for the large, smooth slabs or flagging it affords. Some of the thicker beds furnish also a handsome and useful stone for building. The dip is toward the S.S.W., exposure about twelve feet perpendicular. The stone here shows the characteristic *Leperditia alta*. The quarry is in the old river bank, or hardpan terrace, about forty rods from the stream.

This aspect of the Waterlime is seen in the following places in Wyandot county:

S.W. ¼ Sec. 16, Crane township. At the "Indian Mill" these blue flags have been taken out of the bed of the Sandusky and used for foundations for the mill. But in the construction of the bridge at the same place, the stone used is said to have come from Leesville, Crawford county.

Sec. 21, Crane township. At Carter's dam, in the Sandusky river, Mr. Samuel Strasser has opened the Waterlime. The stone is in irregular thick and thin beds. When freshly quarried it is blue-drab, and of a fine grain. Exposed a short time to the weather the whole pile becomes a bright blue. The fracture of the beds, however, becomes a much more ashen or drab-blue than the sides of the bedding. The dip is W.

Downward Section at Strasser's Quarry.

No. 1.	Very irregular and distorted; beds six to twenty-four inches; firm	3 ft.
No. 2.	Beds one to three inches; fine-grained; lenticular	3 ft.
No. 3.	Beds six to twelve inches; hard and fine-grained	3 ft.
	Total exposed	9 ft.

About thirty rods east of Strasser's quarry, in the bed of the Sandusky, blue flagging is taken out like that of Mr. Carey's quarry on the Tymochtee creek, except that here the blue color pervades the whole mass. Fragments of this, when very bituminous and jointed, come out in long tapering pieces. These flags show a fossil which appears like a species of *Modiolopsis*.

S.W ¼ Sec. 22, Crane township. In the bed of Rock run, a fine-grained blue stone is quarried and used for foundations. It weathers a drab

color to the depth of a half inch, or an inch, all over the outside. One bed only of six inches is exposed.

N.W. ¼ Sec. 27, Crane township. Along the bed of Rock run the Waterlime is abundantly exposed, with a general dip S.E., changing to W. at the west end of the outcrop. Mr. Peter Wynandy here burns lime and sells stone.

Section at Wynandy's Quarry, in descending order.

No. 1.	Irregular drab beds, without showing blue color; two to four inches..	3 ft.
	[Separated from No. 2 by an interval of only occasional exposure of rock, apparently the same as No. 1, with dip in the same direction]	15 ft. ?
No. 2.	Drab beds; more regular; of two to four inches; used for quicklime; separated by brown bituminous films, which, when freshly taken out are more blue. The stone itself, especially in some of the thin bituminous layers (or films), is occasionally tinged with blue	4 ft.
	[Separated from No. 3 by an estimated interval of thirty feet, in which there are occasional exposures, showing the same dip and character of rock as No. 2]	30 ft. ?
No. 3.	This only differs from Nos. 1 and 2 by the blue color of the freshly quarried stone. It lies also, perhaps, in evener beds, and furnishes large, handsome, blue blocks, the thickest of which is not over six inches. These thick beds have every conceivable alternation with thinner, more bituminous beds, which are also sometimes so thick as to constitute a bituminous shale, but are usually only a tough slate	5 ft.
	Total exposure	57 ft. ?

The change of color from blue to drab is very noticeable in the stone quarried from No. 3. Beds which certainly cannot have been fractured more than a few months, were seen to have already acquired a coating of drab one-eighth to one-fourth of an inch thick *over the fractured surface.* The layers themselves, before quarrying, are sometimes one-half to two-thirds drab, with a blue streak through the center. It would seem as if the drab were entirely an acquired color, and that, perhaps, the whole Waterlime was at first a blue rock. The access of air or aerated water seems to cause the change. The fact that the lower, regular beds (as at this quarry), shut off the percolations of water through the rock, may account for the longer preservation of the blue. Whenever the beds are lenticular or irregular, or are so situated that the atmosphere finds free access to them, they are drab. They are seen to be blue only when deep-seated or lying very true.

East side of Sec. 28, Tymochtee township. The Tymochtee slate is

seen in the bed of the Sandusky at Haman's mill. Handsome flags about two inches thick are taken out.

Sec. 22, Pitt township. Mr. James Anderson's quarry shows the following descending section in the bank of the Sandusky:

No. 1.	Bituminous; dark drab or brown; earthy and carious; in one vesicular bed. (The equivalent of No. 10 in the foregoing "section of the Tymochtee slate")	10 in.
No. 2.	Very hard; almost flinty, irregular beds of one-fourth inch to two inches; brown and blue on fracture; sometimes cemented so as to appear massive; with cavities containing loose, disintegrated material like much of No. 1	5 ft.
	Total exposed	5 ft. 10 in.

When No. 1 is constantly wet it is dark brown, but in the weather it becomes light brown. There are sometimes bituminous films visible on a fractured edge; no fossils.

S.W. ¼ Sec. 10, Pitt township, Mrs. Rebecca Smith owns a quarry in the Sandusky, from which a fine-grained, even bedded, blue stone, is taken, which weathers an ashen color. Here are some handsome beds, six to eight inches thick, affording a fine building material. Dip S.E.

At various other points in Pitt township, the same features of the Waterlime may be seen. No reliable estimate can be made of the thickness exposed, or of their relative places in the formation, the outcrops are so isolated, and show so nearly the same characters. The same stone is quarried in the river at Upper Sandusky, by Mr. William Frederick.

In Sec. 17, Crawford township, Mr. George Mulholland, and on Sec. 24, Messrs. Mitten & O'Brien, have quarries in the Waterlime. The stone from these openings is in thick beds, much like the gray, hard beds of the "quarry No. 3," at Tiffin.

The *Lower Corniferous* may be seen in interrupted outcrop along the Sycamore creek, from Benton, in Crawford county, to Sec. 18, in Sycamore township, Wyandot county. Through the whole of this distance it is so hid by drift that no reliable section can be obtained. It is of the coarse-grained, thick-bedded, harsh and magnesian type, until, just within Sec. 17, Sycamore, the character of the rock changes. It assumes very much the aspect of the drab, thin-bedded Waterlime. A little farther down the creek, the soft, thick beds of the Lower Corniferous return. Further still, there is another similar change to a fine-grained, compact, light-blue stone without fossils. This character continues through the most of Sec. 27, and some in Sec. 21, evinced, not often by the rock *in situ*, but by the angular, bluish, fine-grained pieces in the stream. This member of the Lower Corniferous was also seen near Mel-

more, in Seneca county. No opportunity has been afforded to ascertain its thickness, but judging from the superficial exposure, it may have a thickness of thirty or even fifty feet. In the N.W. ¼ Sec. 21, Sycamore, about eighteen inches of similar compact blue limestone may be seen in the creek, underlain by a blue shale which crumbles conchoidally, and shows spots of darker blue or purple. It is sometimes quite rock-like, yet when long weathered it crumbles. Its thickness cannot be stated, though there cannot be less than ten feet, judging from the distance it occupies the bed of the creek. On Sec. 18, of the same township, a thick-bedded, even-grained rock, harsh like a sandstone, is slightly exposed. It is gray, without visible fossils, and weathers buff. It is impossible to give its dip, thickness, or relation to the shale just mentioned. It probably lies below that. Near the same place, land of Andrew Bretz, there are also large fragments of a fragile, bituminous, crinoidal limestone, seen in the bed of the creek.

In Pitt township, S. W. ¼ Sec. 25, on the land of Jacob Brewer, the Lower Corniferous is slightly exposed in the upper bank of the Sandusky river. The rock consists almost entirely of the coral *Cœnostroma monticulifera, Win.* Only a thickness of about a foot can be seen *in situ*, but a mass of two feet thickness is tilted up so as to present the edges of the beds in a perpendicular position.

THE DRIFT.

Wherever sections were observed throughout the county, the drift shows, as in counties further north, the two usual colors. The first is light brown or ashen, and extends downward about twelve feet. It may be stratified or entirely unstratified, and forms the soil where it has not been covered with alluvial or marshy accumulations. Its color alone distinguishes it from the underlying blue, or Erie clay. They both contain bowlders that show glacial action. On Sec. 24, Crawford township, the lower member was seen exposed 27 ft. 4 in. in the bank of Tymochtee creek, embracing beds of gravel and sand. The upper, overlying, was twelve feet, and entirely unassorted; yet on Sec. 18, Tymochtee township, both are more or less stratified, as in the following diagram. No two sections of this bank would be the same. The greatest uniformity in the order of alternation is in the upper part. The blue hardpan sometimes extends upward quite to the brown clays and sands, and in one case, the whole bank consists of hardpan, the upper portion having the brown color.

The following perpendicular section was taken. It will convey an

idea of the general character of the bank, and of the drift in Wyandot county.

No. 1. Fine, crumbling, brown clay, assorted ..... 4 ft.
No. 2. Fine, compact, yellow sand ..... 8 in.
No. 3. Brown, sandy clay ..... 1 ft.
No. 4. Fine, crumbling, brown clay ..... 6 in.
No. 5. Brown, sandy clay, and fine, yellow sand, in irregular beds ..... 1 ft. 4 in.
No. 6. Fine, yellow sand ..... 1 ft. 4 in.
No. 7. Clean, fine sand, with many limestone pebbles, and fragments of black slate ..... 2 ft.
No. 8. Rusty sand ..... 8 in.
No. 9. Clean, blue sand; water-bearing ..... 3 in.
No. 10. Compact, fine, brown clay; assorted ..... 6 in.
[To this point the brown color prevails.]

No. 11. { *a.* Assorted, fine, blue clay ..... ; *b.* Sand in oblique stratification; changing to gravel ..... ; *c.* Blue clay; assorted ..... ; *d.* Sand and clay; blue ..... ; *e.* A bed of about three feet of sand, the strata standing nearly perpendicular; with alternate streaks of blue and white sand ..... ; *f.* Fine, blue, assorted clay ..... } 5 to 6 ft.

No. 12. Blue hardpan, containing gravel-stones, pebbles and scratched bowlders. Near the bottom is a bed of very fine blue clay, of at least eight inches, perfectly assorted and free from pebbles. Below it, however, are several feet of hardpan; about ..... 25 ft.

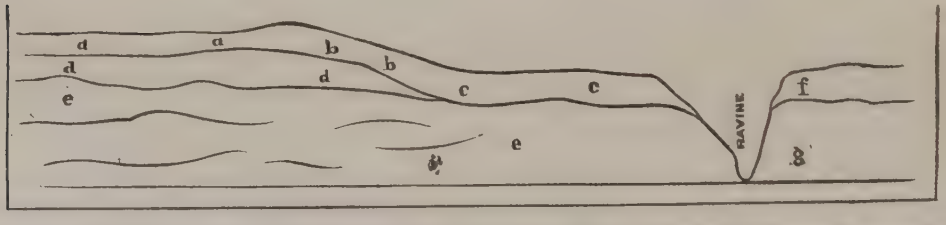


Diagram of the front view of the bank of the Tymochtee creek, showing the general superposition of the principal parts of the foregoing section. In the bed of the creek the Waterlime is in outcrop. (*Figure reduced for wood-cut.*)

EXPLANATION OF FIGURE.

a. Brown clay and sand; stratified.
b. Brown hardpan.
c. Stratified brown clay.
d. Stratified blue clay and sand.
e. Fine blue clay and blue hardpan.
f. Brown clay.
g. Blue clay.
h. *Debris;* bowlders and slides.

On the opposite side of the creek this bank is entirely wanting. There is a bank of a trifle over twelve feet, composed of agglutinated, rusty sand, without gravel or bowlders, at the base of which, near the water, is a bed of vegetable remains containing some pretty large limbs and numerous branches of wood. Such deposits are common in the alluvial bottoms bordering the streams. There is a gradual ascent from the level of this bank to the height of the bank on the opposite side of the river, attaining that elevation in a distance of forty rods.

MATERIAL RESOURCES.

As already remarked of other counties in north-western Ohio, the chief source of material wealth in Wyandot county lies in its rich and exhaustless soil. The streams are generally too small or too sluggish to be reliable for water-powers. The rocks themselves are not known to possess any deposits of valuable minerals. They will serve for common use in building, and will make an excellent quicklime. There is reason to believe, also, that the Waterlime, when having the characters seen in the quarry of Mrs. Smith, Sec. 10, Pitt township, will afford a cement of hydraulic properties.

Good brick of a red color are made in different places in the county from the surface of the drift. Such establishments are owned at Upper Sandusky by Jacob Gottfried and brother, and by Ulrich and McAfee; also on the S.E. ¼ Sec. 11, Salem, on the Infirmary Farm, by Jacob Ulrich. Sand for mortar is easily obtained from the numerous natural sections of the drift along the drainage valleys. A sand bank at Upper Sandusky was observed to underlie a deposit of eight feet of brown hardpan, and was excavated to the depth of ten feet. The layers of sand lay nearly horizontal.

CHAPTER XXIX.

GEOLOGY OF MARION COUNTY.

SITUATION AND AREA.

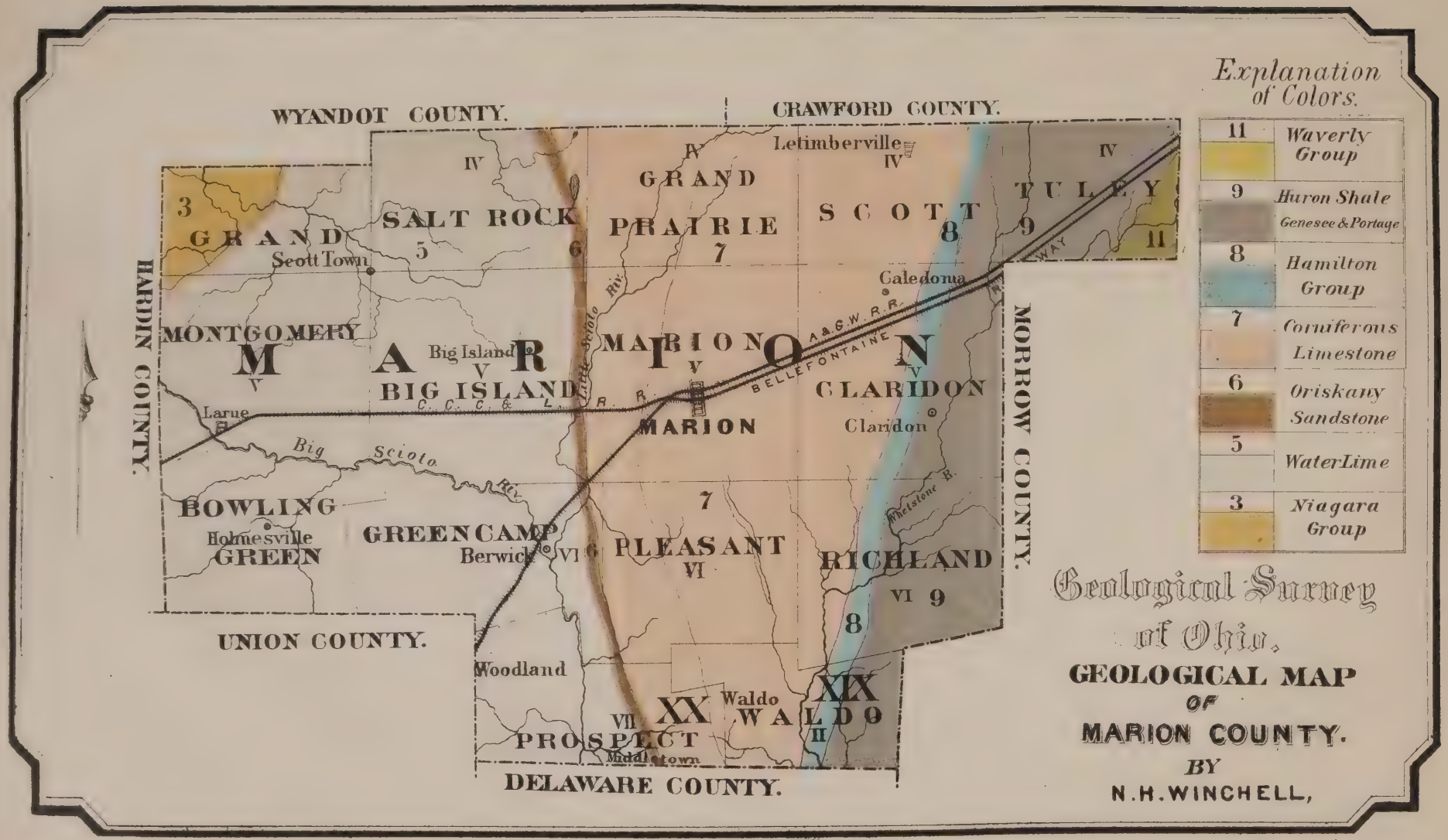
Marion county lies on the broad water-shed between the Ohio river and Lake Erie, about fifty miles south of the west end of that lake. It comprises about eleven towns. It is immediately south of Wyandot and Crawford counties. It has Morrow on the east, Delaware and Union on the south, and Hardin on the west.

NATURAL DRAINAGE.

It contains no large rivers. The Scioto, which enters it from the west, is the largest, and leaves it at Middletown in a southerly course. The Little Scioto traverses the county about midway, joining the Scioto at Berwick. The Whetstone also crosses it in the eastern tier of townships in a southerly direction. The waters of the Tymochtee and Little Sandusky take their rise in the north-western portion of the county, and find their way to Lake Erie.

SURFACE FEATURES AND SOIL.

Much of the county is flat, and has a black prairie soil, especially in the townships of Bowling Green, Big Island, Salt Rock, Grand Prairie, Scott, Claridon and the western part of Marion. The streams that cross these prairie-like tracts, are but four to six feet below the level of the land, and in time of freshet probably inundate considerable areas. There are, however, sudden changes in the character of the surface, even in the midst of the prairies. Mounds of the unmodified hardpan still project above the general surface. These have a rolling contour, and an ashen clayey soil. They are generally covered with forest, while the prairies



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are treeless. The remaining portions of the county, namely, the townships of Grand, the northern portion of Montgomery, Greencamp, Pleasant, Richland, Tully, and the eastern part of Marion, are on the old drift surface, and have, with an undulating or rolling outline, a soil of brown or ashen clay, containing pebbles and bowlders.

GEOLOGICAL STRUCTURE.

The geological range of Marion county is from the Niagara to the Waverly, being greater than that of any other county in the State. It thus contains, approximately:*

Waverly sandstone	140 ft. ?
Huron shale (Black slate)	250 ft.
Hamilton limestone	20 ft.
Upper Corniferous	50 ft.
Lower Corniferous	150 ft.
Oriskany sandstone	20 ft.
Water limestone	100 ft.
Niagara limestone	40 ft.
Total	780 ft.

The Niagara limestone, the lowest in the scale, is found in the northwestern part of the county, and is followed toward the east by the higher members in the order above given, the general dip of the whole being in that direction. The Waterlime occupies the most of the townships of Salt Rock, Big Island, Greencamp, Montgomery and Prospect, and all of Bowling Green. The Lower Corniferous strikes across the western side of Grand Prairie and Marion townships, touching Pleasant and Prospect townships east of the Scioto river. The Upper Corniferous underlies the remainder of Grand Prairie, Marion, Pleasant and Prospect townships, and the western portions of Scott, Claridon, Richland and Waldo. The Hamilton occupies a narrow belt just on the east of the Upper Corniferous. The Black slate underlies the eastern portions of Waldo, Richland, Claridon, and most of Tully townships. The Waverly is found only in the eastern part of Tully. Of these, the Oriskany and the Lower Corniferous have not been seen in outcrop in the county, owing to the unbroken mask of the drift deposits, and the other formations offer very meager opportunities for learning their characters. It is only by tracing their

* Since this was written, Prof. Orton's Report on the Geology of Highland County has been published. He reports that county as ranging from the Lower Silurian to the Carboniferous, which exceeds Marion in range of time, but with the absence of three members of the scale—the Oriskany, Corniferous and Hamilton.

lines of outcrop from other counties where they afford better facilities for observation, that their presence and their contents in Marion county can be asserted by the geologist.

The *Niagara* was examined in the following places in Grand township:

S.E. Sec. ¼ 19, where Jeremiah Winslow has burned a little quicklime. Dip S.E.

N.E. ¼ Sec. 19. A small creek which flows north-easterly across this section into the Little Tymochtee creek, lies immediately on the hard, gray Niagara, for the distance of over half a mile, on land belonging mostly to Mr. S. Hartle. Formerly a great deal of lime was burned from the rock along this creek. The dip is to the N.E., but toward the most westerly point of exposure, the surface of the rock presents sudden changes of dip, disappearing with a dip W.

The *Waterlime* is only seen in the bed of the Scioto at Middletown, near the southern border of the county. At that place, and about two miles further south, in Delaware county, also in the bed of the Scioto, it appears as an even bedded drab rock, bluish on the laminations, and blotched throughout with blue and drab. The beds are two to four inches thick, but sometimes not more than an inch; and some blocks are ten inches thick. The blue and drab colors vary and interchange in all shapes and directions, without reference to the bedding, except that it is not uncommon to see a drab surface to the depth of one-half inch to an inch and a half, with a blue strip through the middle. The surfaces of the beds are diversified with mud cracks, and separated by bituminous films. The stone is slightly vesicular, with small cavities, yet for the most part firm and apparently compact. It is a handsome and useful building material, comparing favorably with the Upper Corniferous for all uses.

The *Upper Corniferous*, in the township of Grand Prairie, is worked quite extensively on N.W. ¼ Sec. 26, by Mr. James Dawson. Here the beds dip slightly toward the east; perpendicular exposure about twelve feet, facing the west.

In this immediate neighborhood are the following quarries, also in the Upper Corniferous:

S.W. ¼ Sec. 23. By Adam Coonrod.
S.W. ¼ Sec. 23. By Philip Rhetter.
N.W. ¼ Sec. 26. By heirs of Landy Shoots.
N.E. ¼ Sec. 27. By Eli Powell.

At Marion, the Upper Corniferous is extensively wrought by Seas & Haberman, and by Franklin Swaigler, who have, in adjoining quarries, an exposure of about twelve feet of perpendicular bedding. Dip E. Sim-

ilar beds are also wrought by John Ballentine, by Joshua Finch, and by Nathan Powers.

S.W. ¼ Sec. 10, Marion township, Mr. Elijah Hardy burns lime from the Upper Corniferous.

S.E. ¼ Sec. 9, Marion township, Mr. Leonard Reiver has taken out some stone from the Upper Corniferous.

Four and a half miles south of Marion, in Pleasant township, Mr. John Owen burns and ships at Marion considerable quantities of quicklime. Sells building stone on the ground at fifty cents per ton. Dip E.

In Richland township, the Upper Corniferous appears in the Whetstone on Secs. 30 and 19, and is quarried on the land of Daniel Oborn; also on the land of Mr. George King, N.E. ¼ Sec. 20.

The *Hamilton.* In the bed of the Whetstone, about a mile below the village of Waldo, may be seen a very hard, blue, pyritiferous limestone, in beds of eight to twelve inches, which is believed to belong to the Hamilton, although there is not sufficient exposure within the county to determine its horizon. This would furnish a fine building stone, were it not for the abundance of pyrites crystals contained in the rock. After a few months' exposure to the weather, these will inevitably change to the yellow peroxyd of iron, the rusty drippings of which present an offense to the eye, and soil the beauty of any wall.

The *Huron Shale* is popularly known as "the black slate." At various places in the bed and banks of the Whetstone river, in the townships of Richland, Claridon and Tully, it finds characteristic exposure. It may be seen N.E. ¼ Sec. 16, Richland township, where it is in thin, brittle sheets, and rises several feet along the bank of the stream. It holds large, concretionary masses of a coarse black limestone. These are very hard, and appear arenaceous at the center, with a band of more calcareous and crystalline material round the outside. They sometimes exceed four feet in diameter. Globular masses of crystalline pyrites are also common, often several inches in diameter. The black slate may also be seen in Secs. 3 and 26 of the same township, and Sec. 34 of Tully township, land of James Brown Lee. In the absence of other stone, this slate has been somewhat used for walling wells in the eastern part of the county.

The *Waverly Sandstone* is quarried to a limited extent on land of Mr. James Brown Lee, Sec. 34, Tully township. It here has a position to the west of observed exposures of the underlying Black Slate, and must be an outlier from the more extensive beds of the same stone which lie further east. Other openings are met with on Sec. 36 of the same township, and at Iberia, in Morrow county.

The Drift shows no apparent diminution in Marion county. Since its general character differs in no respect from that already described, but few points of observation will be noted. At Middletown the contents of a gravel bank were noticed to contain a great many large fragments from the Water-limestone, so arranged as to indicate not only the agency of water in rapid currents, but the direction of its flow. Some of these pieces of limestone were as much as two feet across, but usually not over two inches in thickness, and but slightly water-worn. They lay in the midst of gravel which had a stratification dipping rapidly toward the south. The limestone fragments also lay with their sides almost invariably upward, but sloping with less inclination in the same direction, similar to the arrangement of flat stones or other obstructions often seen in the bottoms of streams. It would seem as if the water, precipitated in cascades down the southern slope of the glacier, bringing such dislodged portions of the drift as fell into the current, sought to arrange the obstructions to its flow so as to offer the least resistance.

On the S.W ¼ Sec. 36, Salt Rock township, a well seventy feet in depth through drift deposits, furnished no water—dug on the premises of R. W. Messenger.

About Berwick, and a mile or two west, there are unusual numbers of bowlders, some as large as six feet in diameter. The country about is rolling, and they seem to have been embraced within the drift. In the southern part of Pleasant and Greencamp townships, especially in the vicinity of Middletown, the upper portions of the drift are very apt to contain deposits of gravel and sand, with frequent bowlders.

At Waldo, the drift is seen to consist, along the river bank, of twenty-five feet hardpan. Brown color prevails downward about fifteen feet; blue below that depth, soon becoming sandy, furnishing water. In other places, within a half-mile, the top of the drift is gravel and sand, with only a thin covering of hardpan.

MATERIAL RESOURCES.

Gravel is found in the southern part of the county, and is extensively employed in road-making. Clay, for red pottery and brick, is abundant throughout the county. Stone taken from the various quarries in the Upper Corniferous formation, serves for all purposes of building. It may be employed in the most massive as well as in all ordinary structures, having resistance sufficient to withstand any pressure needed. It is of a light blue or gray color, and when arranged properly in a building, with stone of a lighter shade, it produces a fine architectural effect. In the city of Marion it is employed in the county jail and numerous stores.

Its dark shade produces in a building the æsthetic effect of strength, age and solidity, making it specially adapted to Gothic structures.

The Black Slate has heretofore been esteemed of little or no economical value. It is due, however, to the enterprise of a citizen of Defiance, in Defiance county, Mr. E. H. Gleason, that we have the practical demonstration of the eminent hydraulic qualities of the Black Slate in Ohio. Mr. Gleason uses the lowest seventeen feet of the formation, which attains an aggregate thickness of nearly three hundred feet, with very uniform characters. We have no reason to doubt that the hydraulic property pervades the whole. Owing to the inflammable bituminous matter it contains, the slate is easily and cheaply burned, to a certain extent supplying its own fuel. Six to eight hours of red heat expel all volatile matter, leaving a lime which is easily reduced to a powder. The stone is not selected altogether promiscuously from the quarry. It is thought that the most compact and calcareous courses, which, when burned, are of a grayish or ashy purple, afford the best hydraulic cement. The more slaty and highly bituminous beds, after burning, are of a light cream color, or white with yellowish streaks and spots. Yet more than a half of the stone burned by Mr. Gleason is of the latter quality. The cement has been put to practical test in a number of ways at Defiance, and is now being employed in the abutments of an iron bridge at that place, over the Wabash and Erie canal, in connection with the Oriskany sandstone, quarried at Whitehouse, in Lucas county. Mr. Gleason employs two constant draw-kilns, and grinds the lime by steam power.* It is only necessary to add that in Marion county the base of the Black Slate strikes across the townships of Scott, Claridon, and Richland, and that its exposures along the Whetstone afford ample facilities for a similar enterprise.

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* It is due, perhaps, to the Geological Survey, to add that Mr. Gleason attributes the success of his enterprise to the suggestions and advice of members of the present Geological Corps. Other cases could be named in which the visits of the geologist have resulted in the immediate development of home products.

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